

Hydrographic Context for Chukchi slope fish trawls during RUSALCA 2009

Robert S. Pickart

Woods Hole Oceanographic Institution

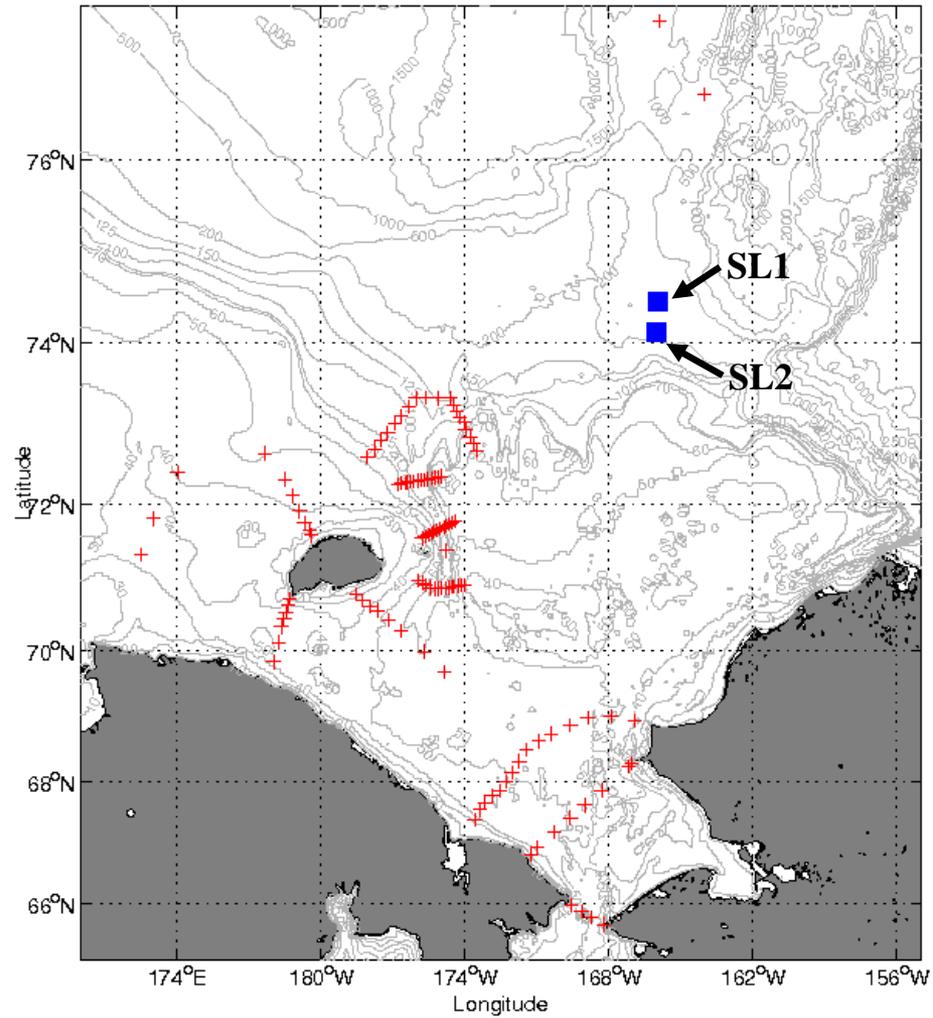
Outline

1. Water mass structure and circulation of Chukchi slope.
2. Recent warming of the Atlantic Water.

Wrangel Island as seen from the
Professor Khormov, Sep 2009
(Photo by D. Torres)

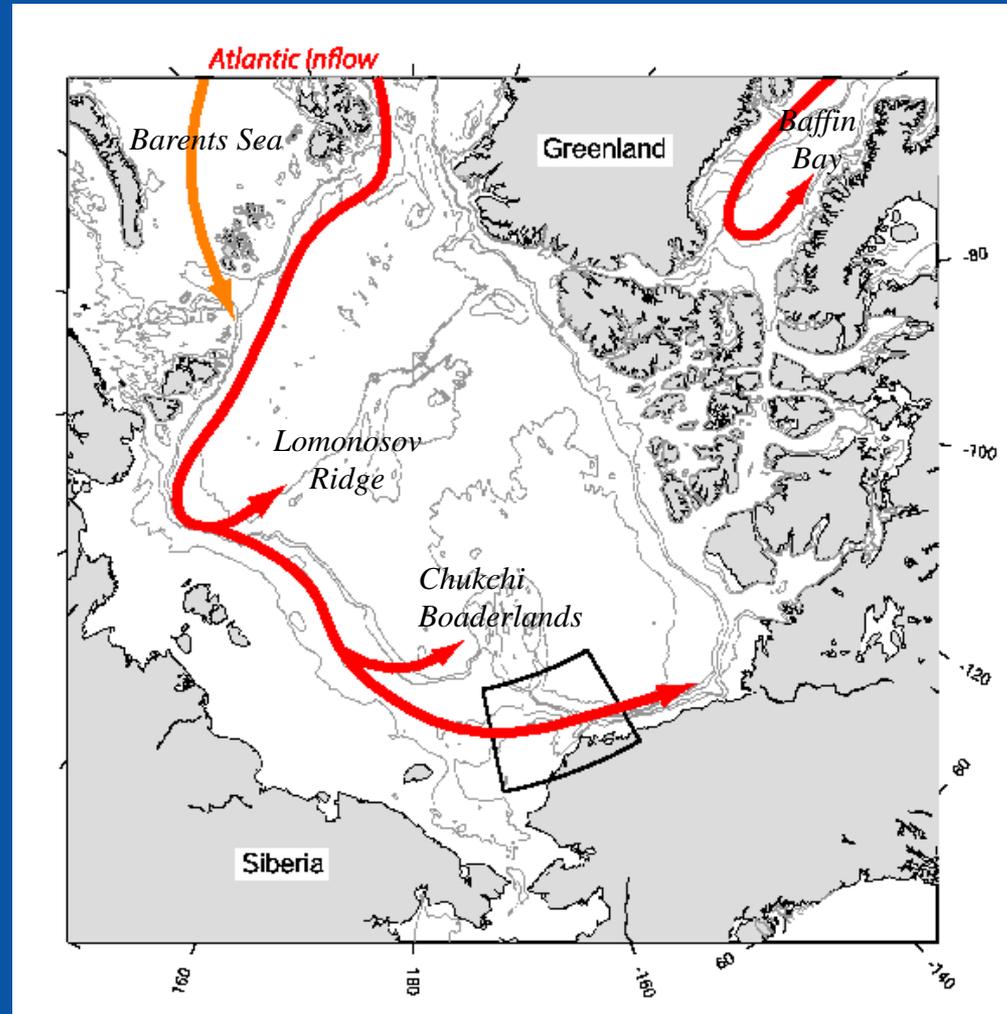


Chukchi slope fish trawl sites



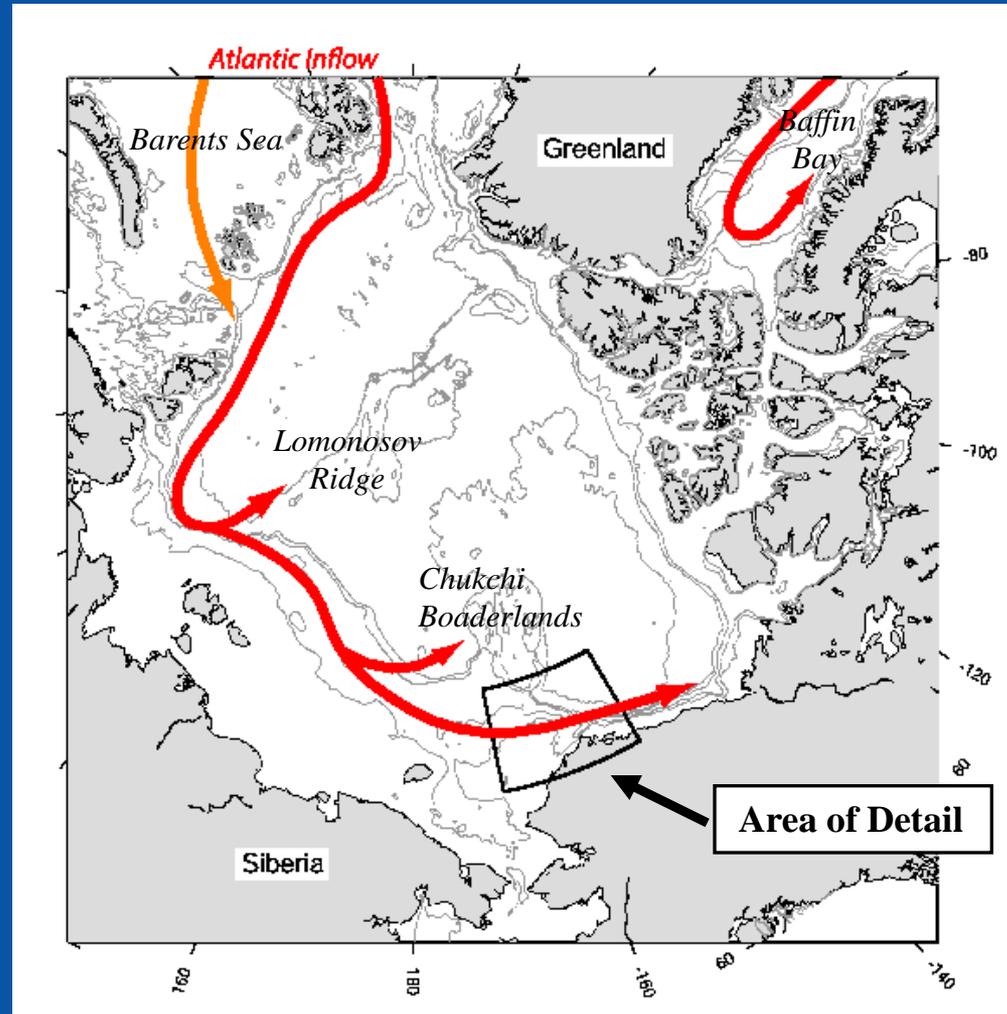


Atlantic Water Circulation



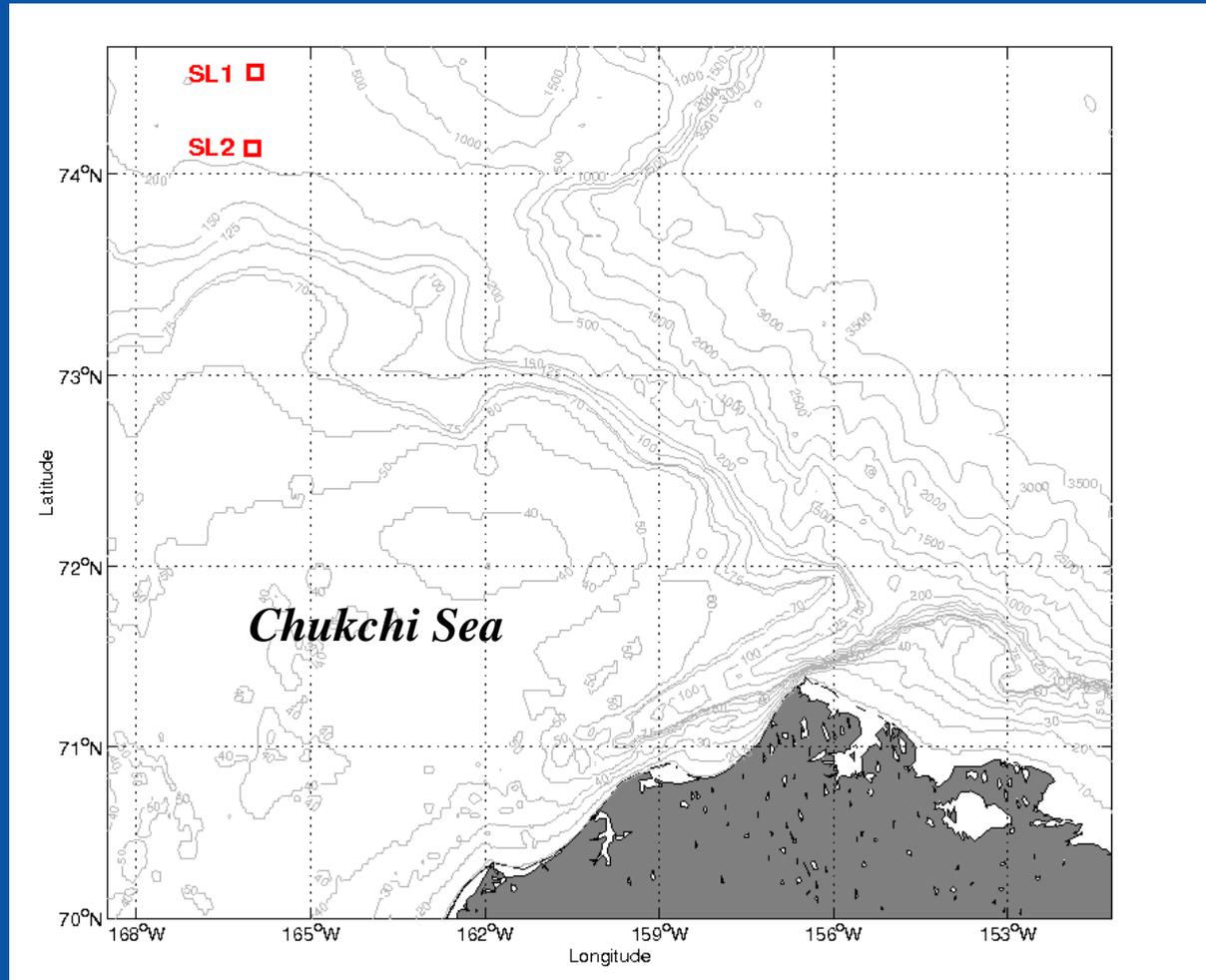


Atlantic Water Circulation



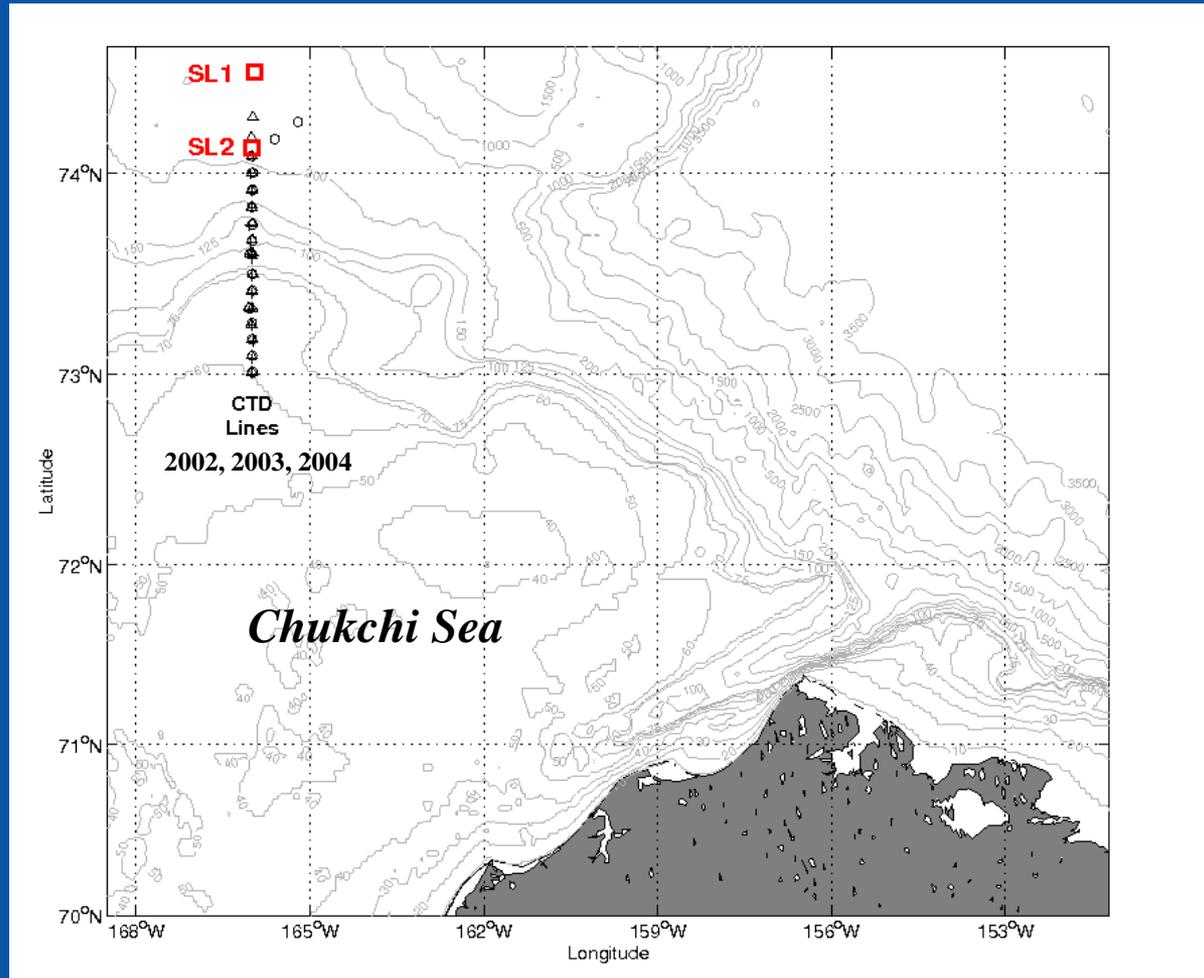


Supporting information





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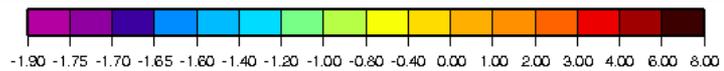
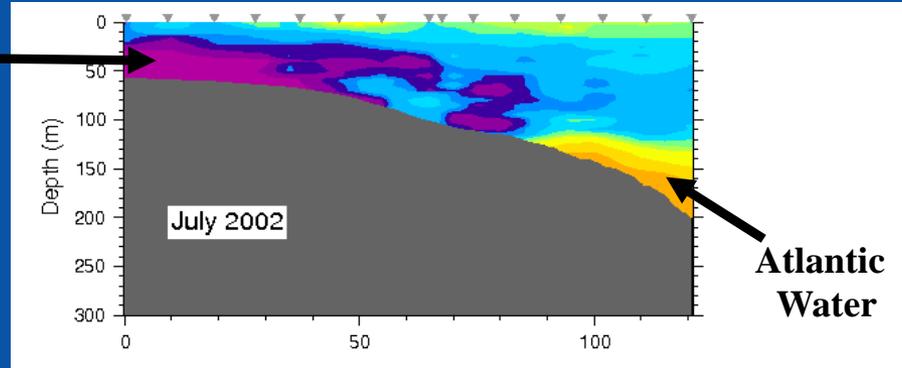




166°W hydrographic sections during SBI

Potential temperature (°C)

Pacific Winter Water

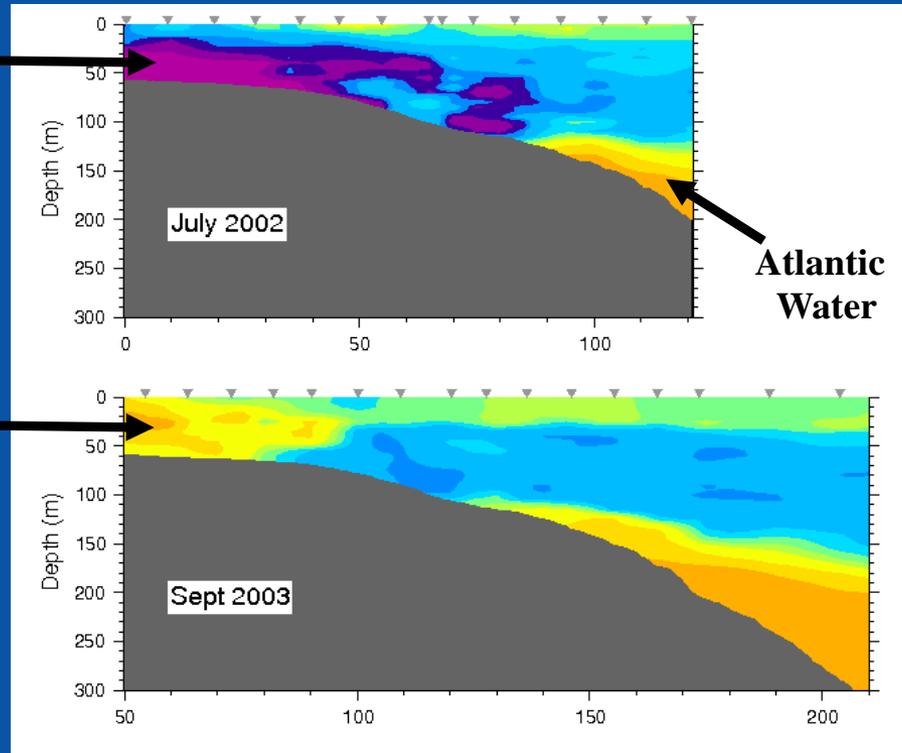




166°W hydrographic sections during SBI

Potential temperature (°C)

Pacific Winter Water



Pacific Summer Water

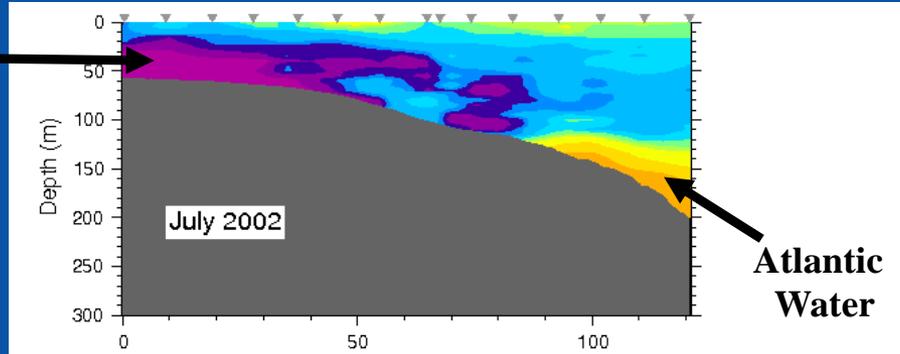




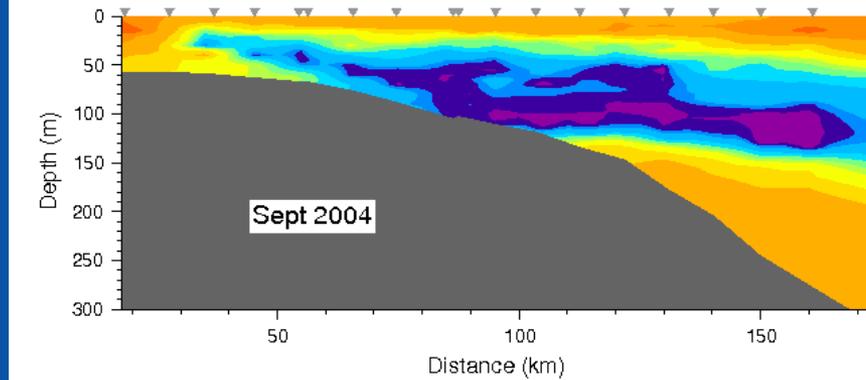
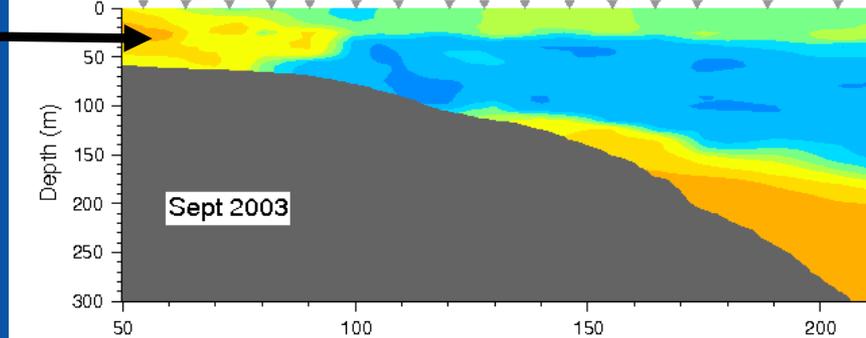
166°W hydrographic sections during SBI

Potential temperature (°C)

Pacific Winter Water



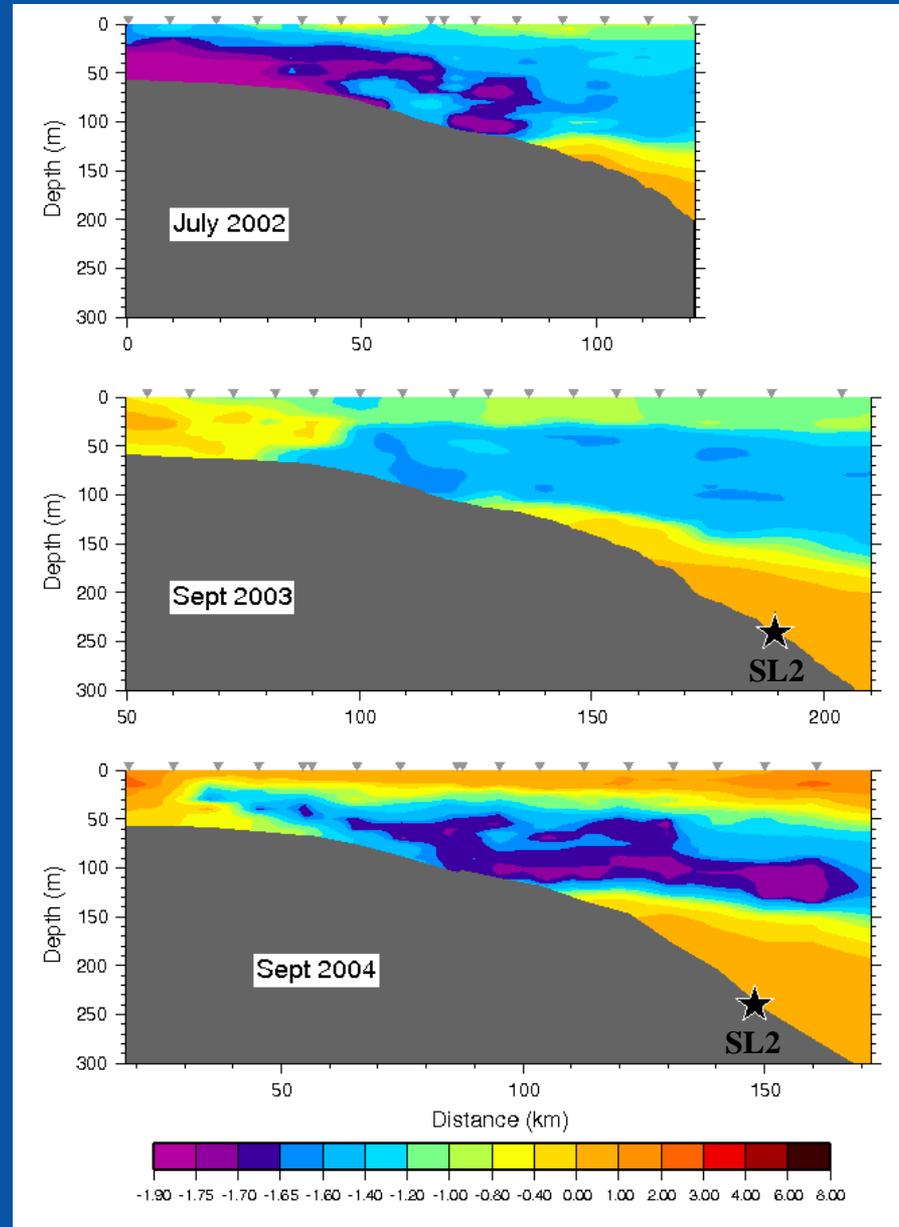
Pacific Summer Water





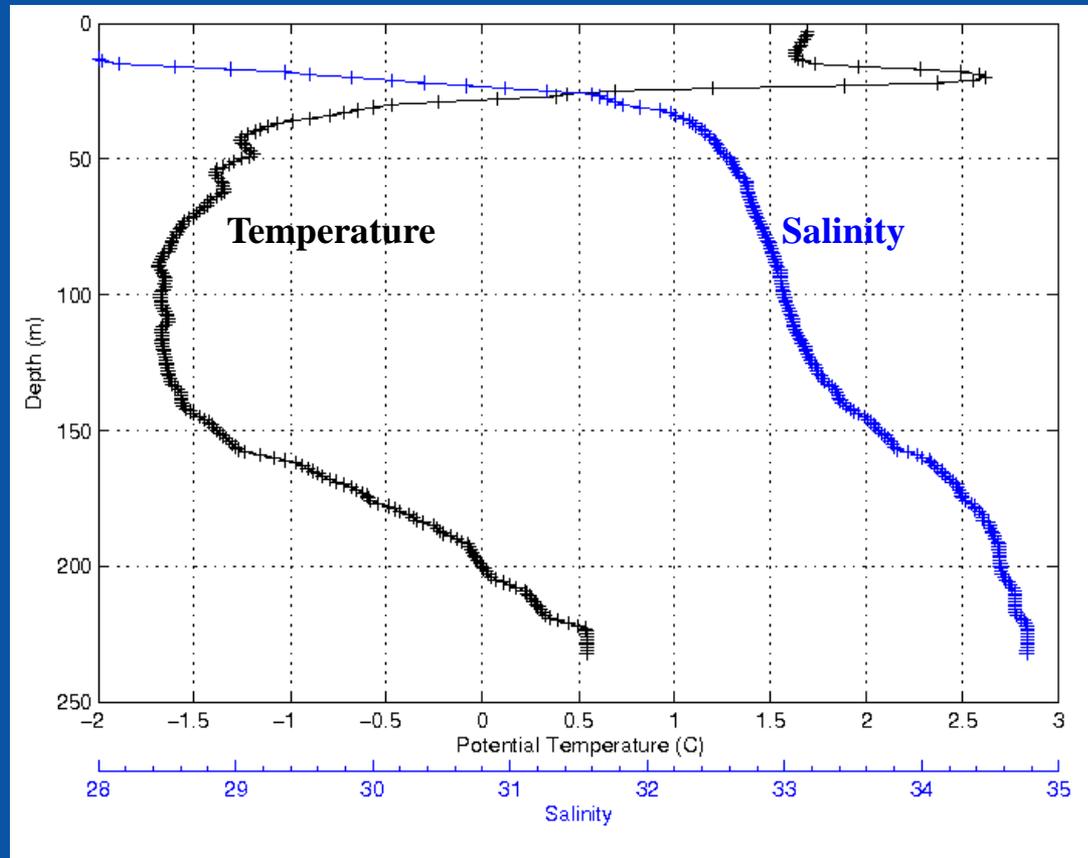
166°W hydrographic sections during SBI

Potential temperature (°C)



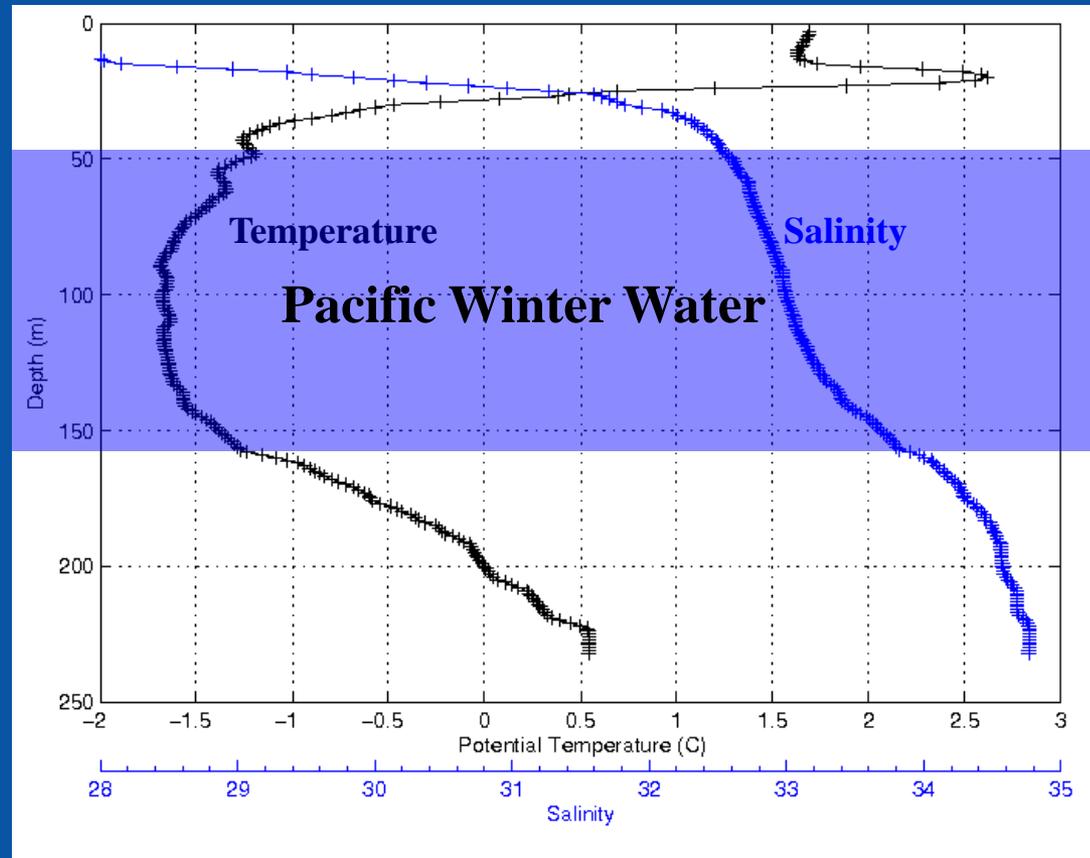


Hydrographic profiles at fish trawl site SL2



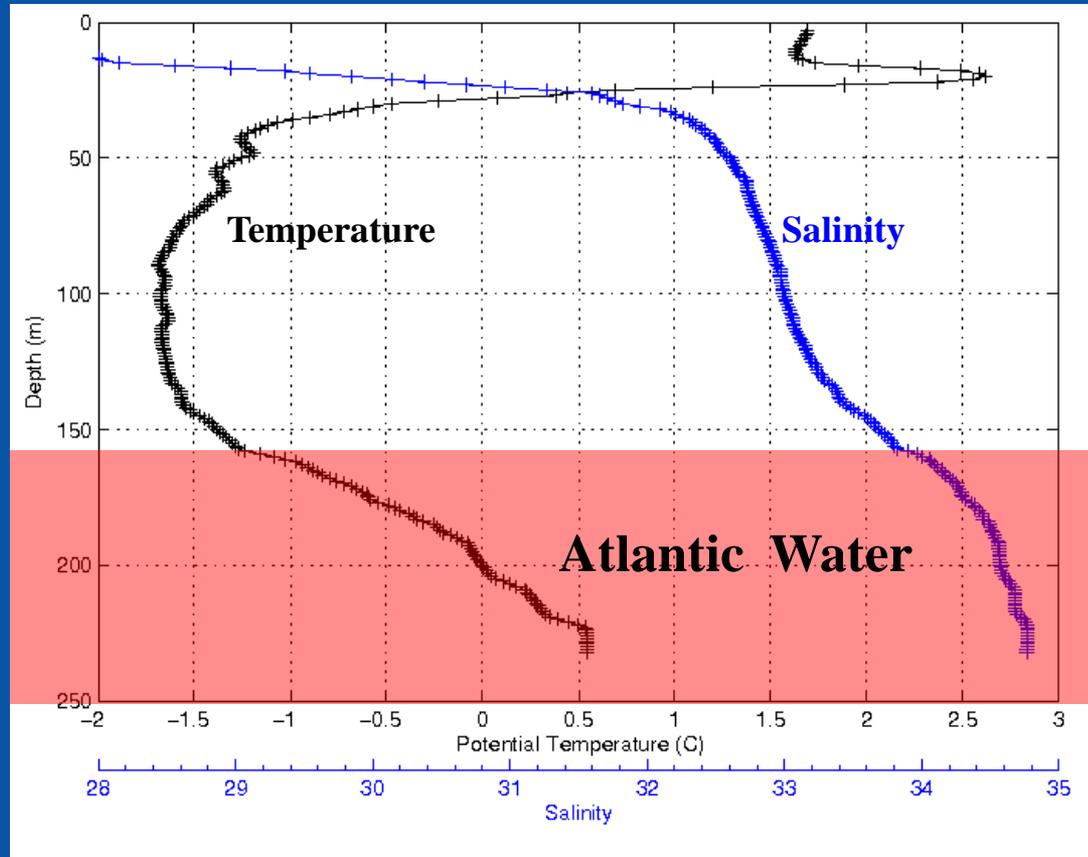


Hydrographic profiles at fish trawl site SL2

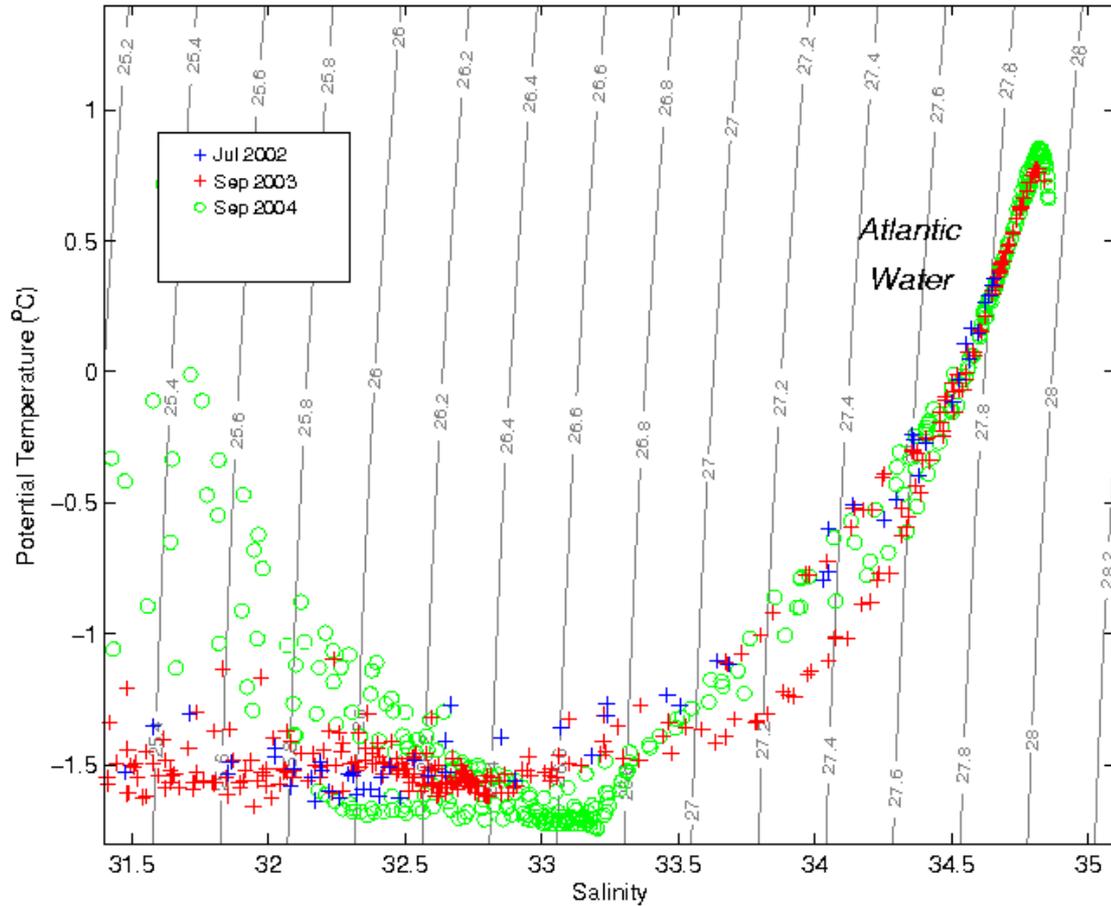




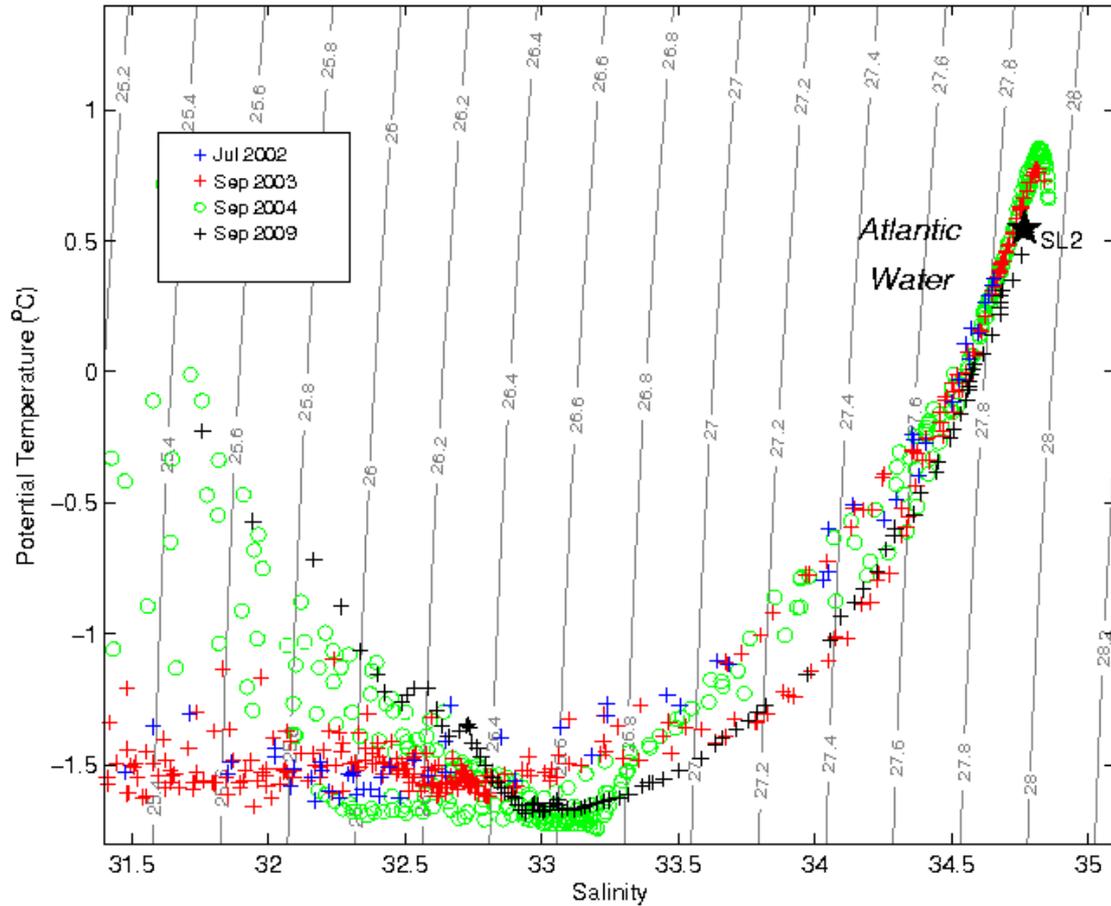
Hydrographic profiles at fish trawl site SL2



Temperature/Salinity Diagrams

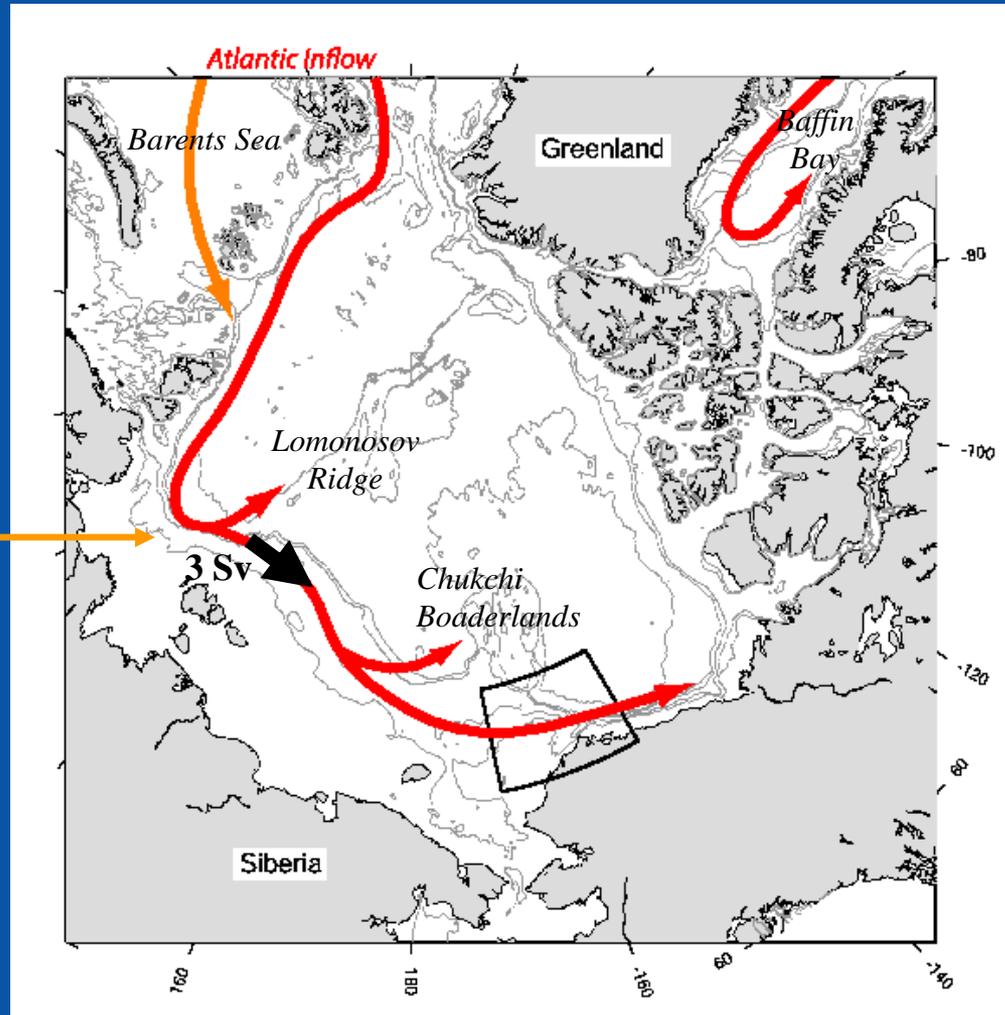


Temperature/Salinity Diagrams



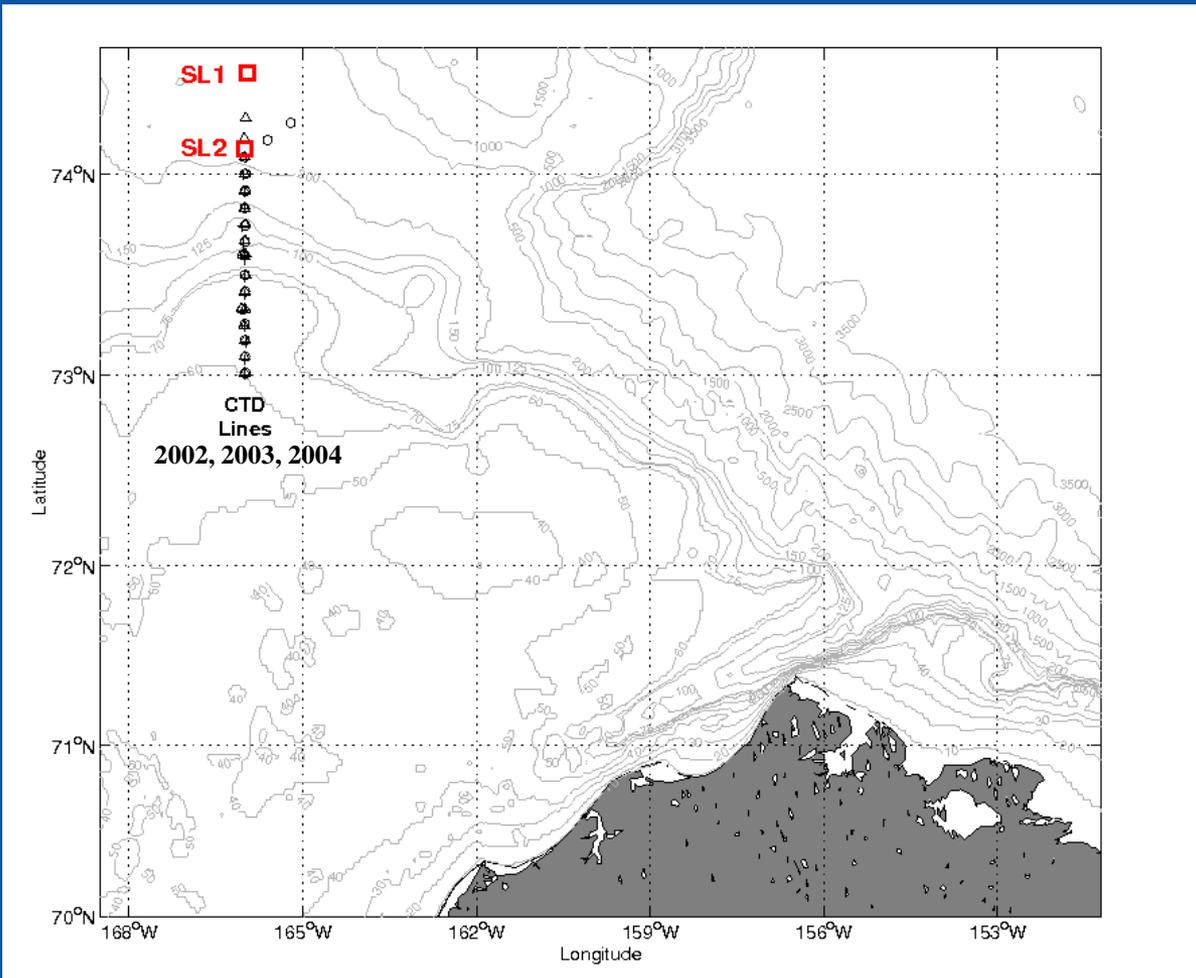
Atlantic Water Circulation

According to Woodgate et al. (2001) using a single mooring



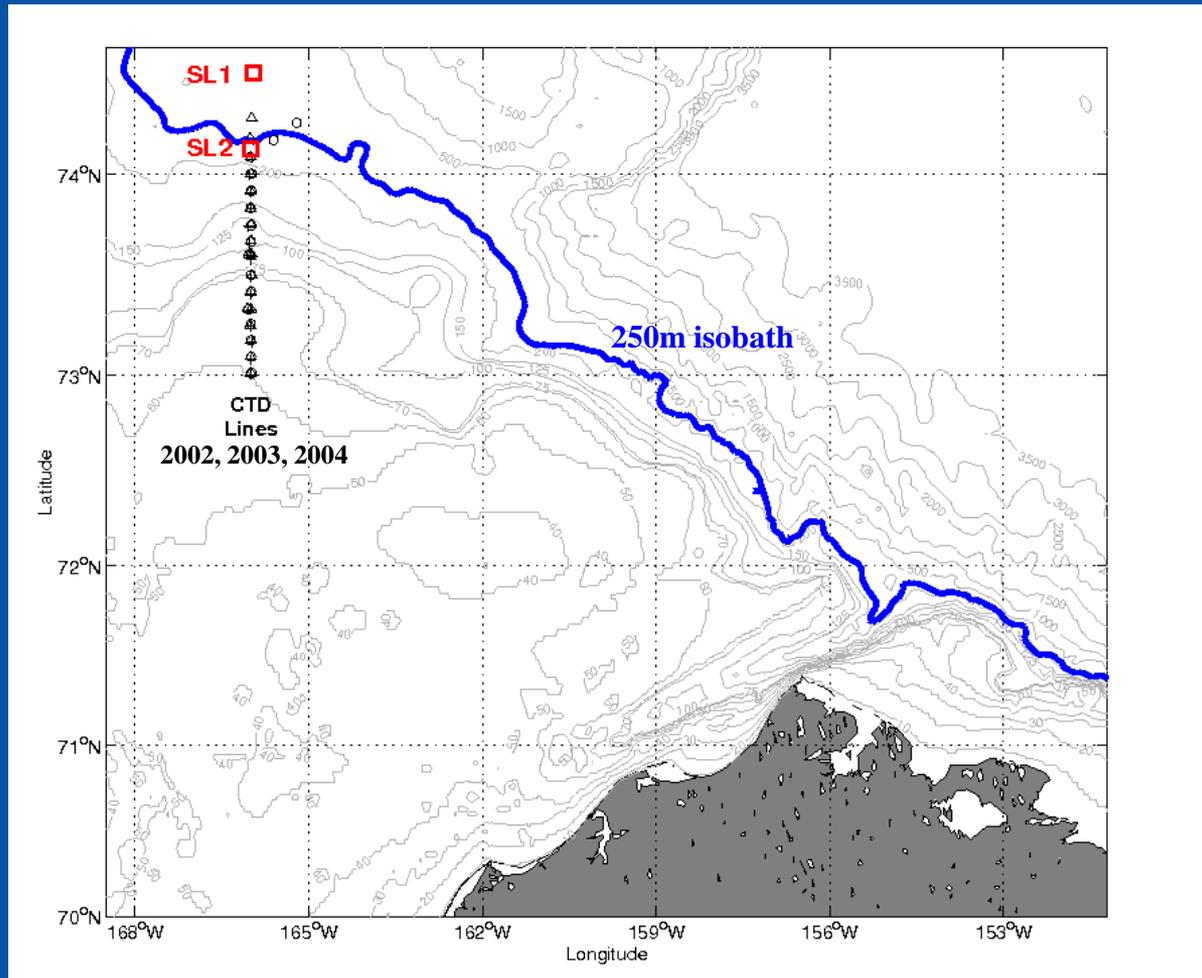


Supporting information

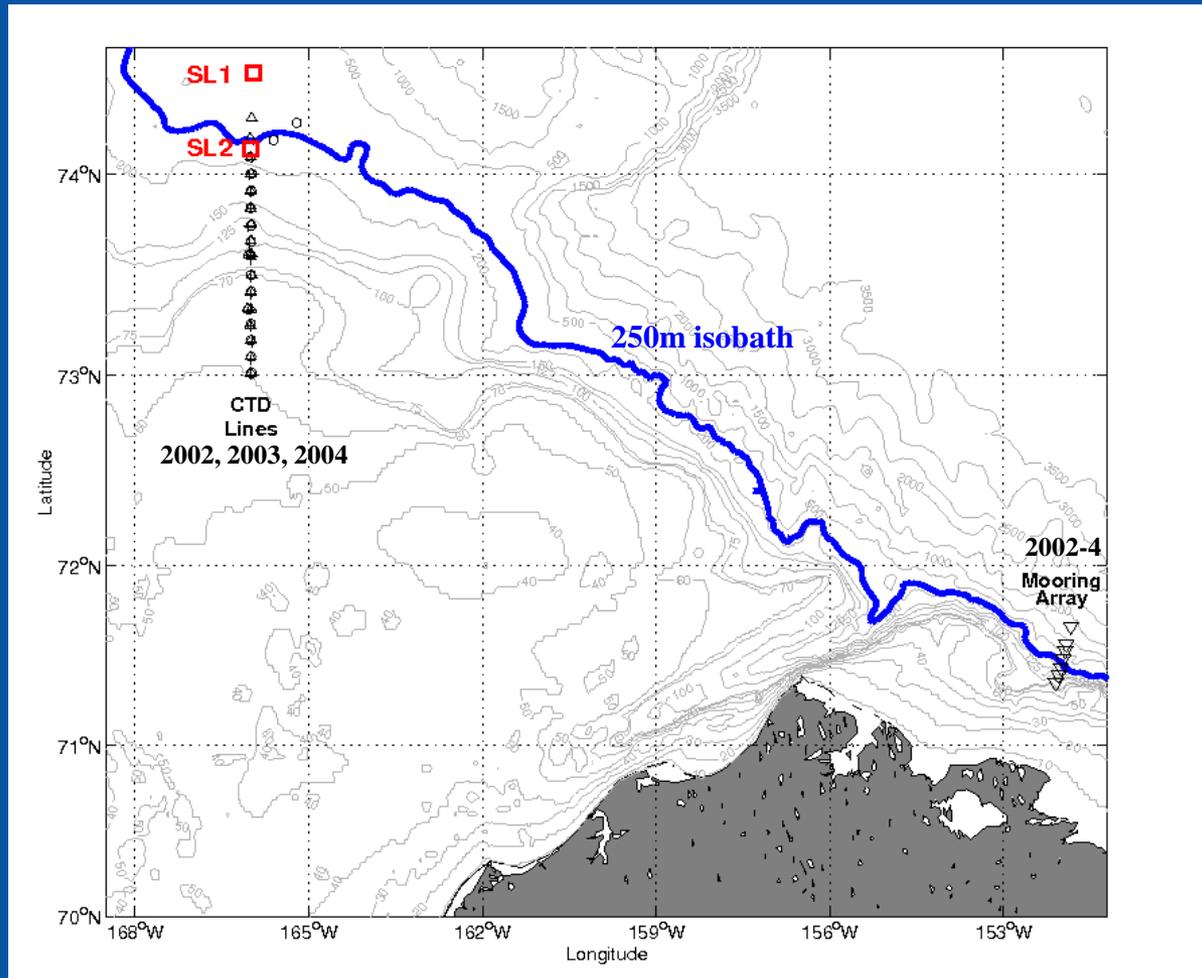




Supporting information



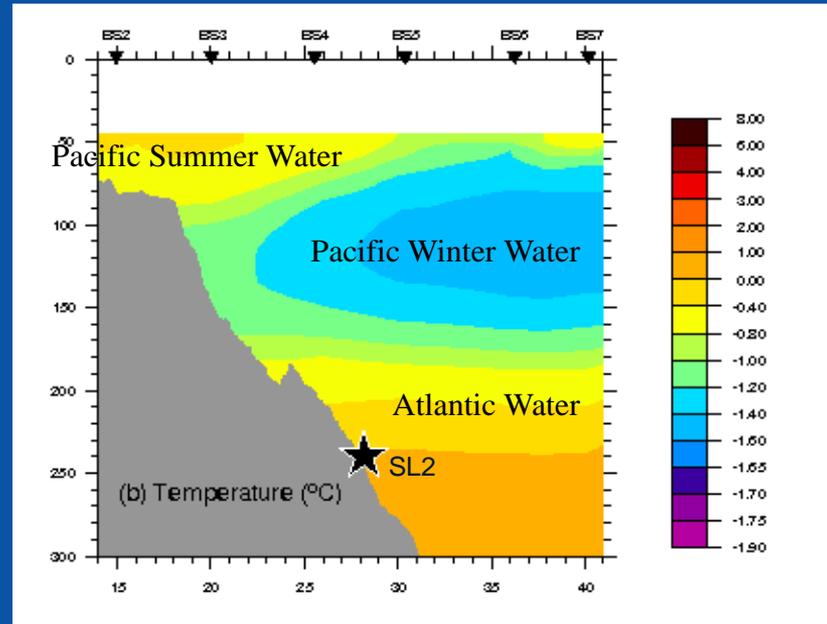
Supporting information





Circulation

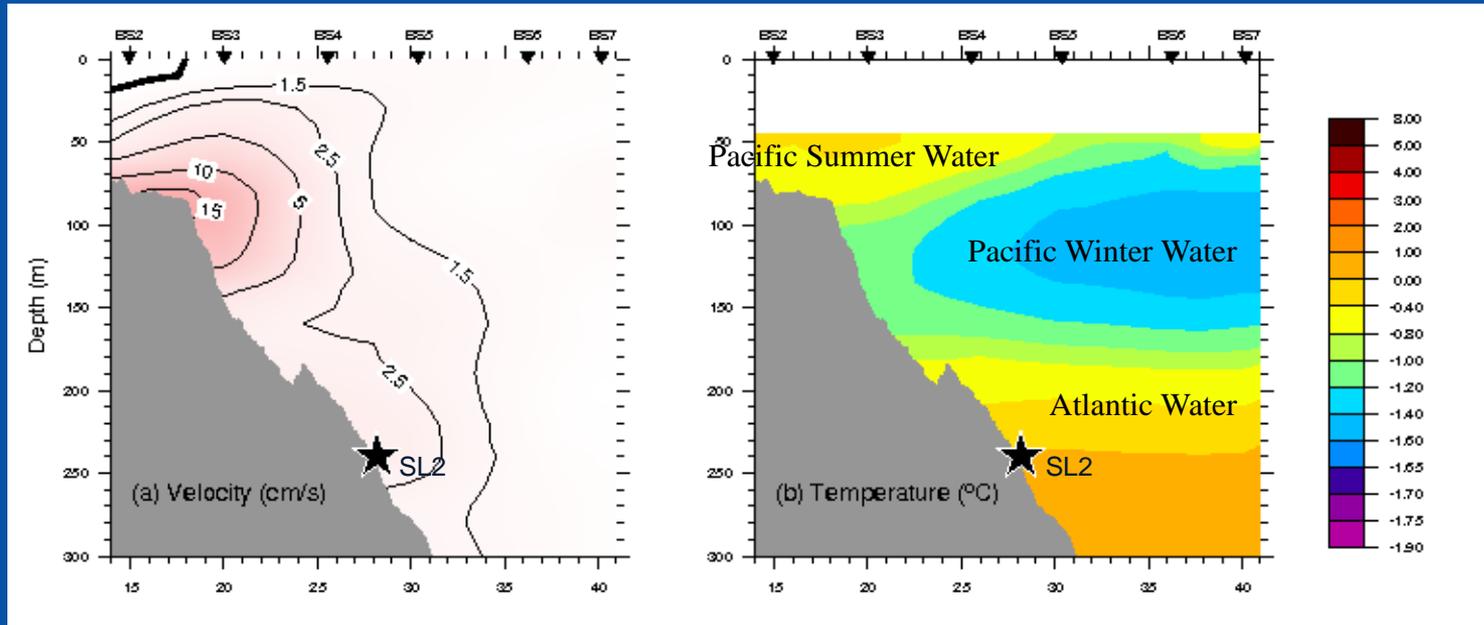
Year-long Mean fields from SBI 152°W Mooring Array





Circulation

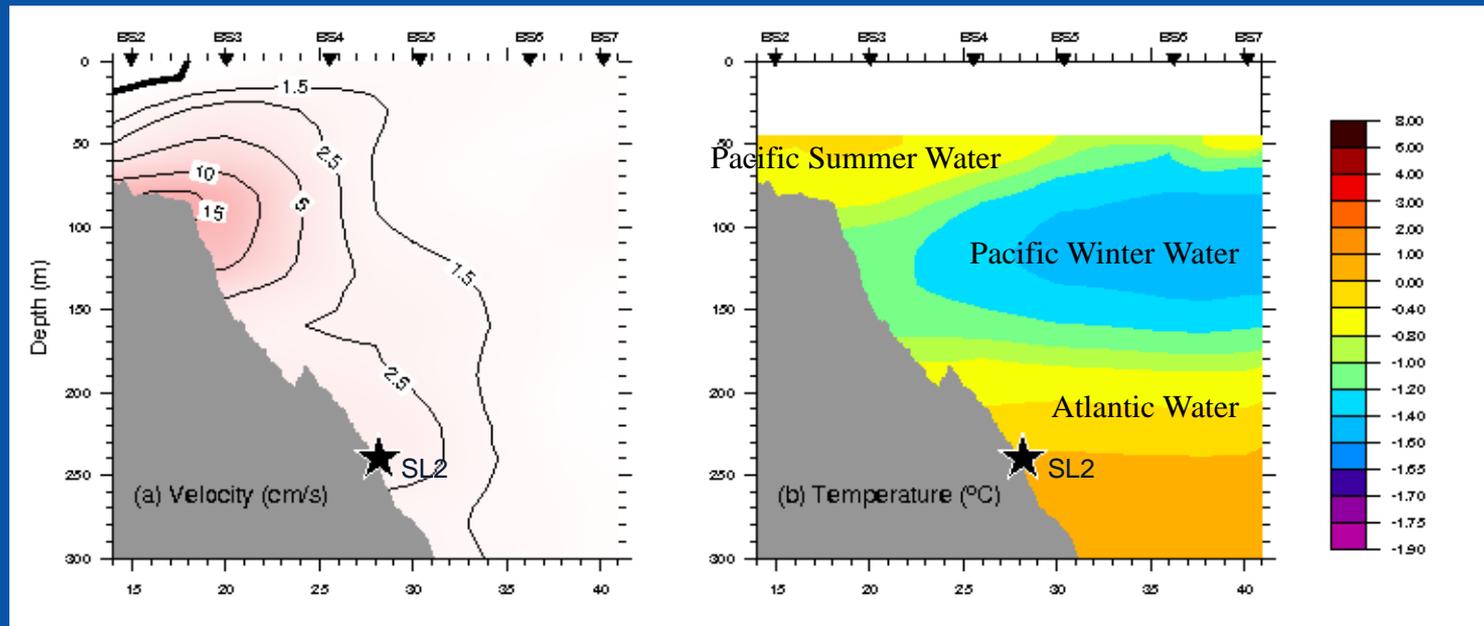
Year-long Mean fields from SBI 152°W Mooring Array





Circulation

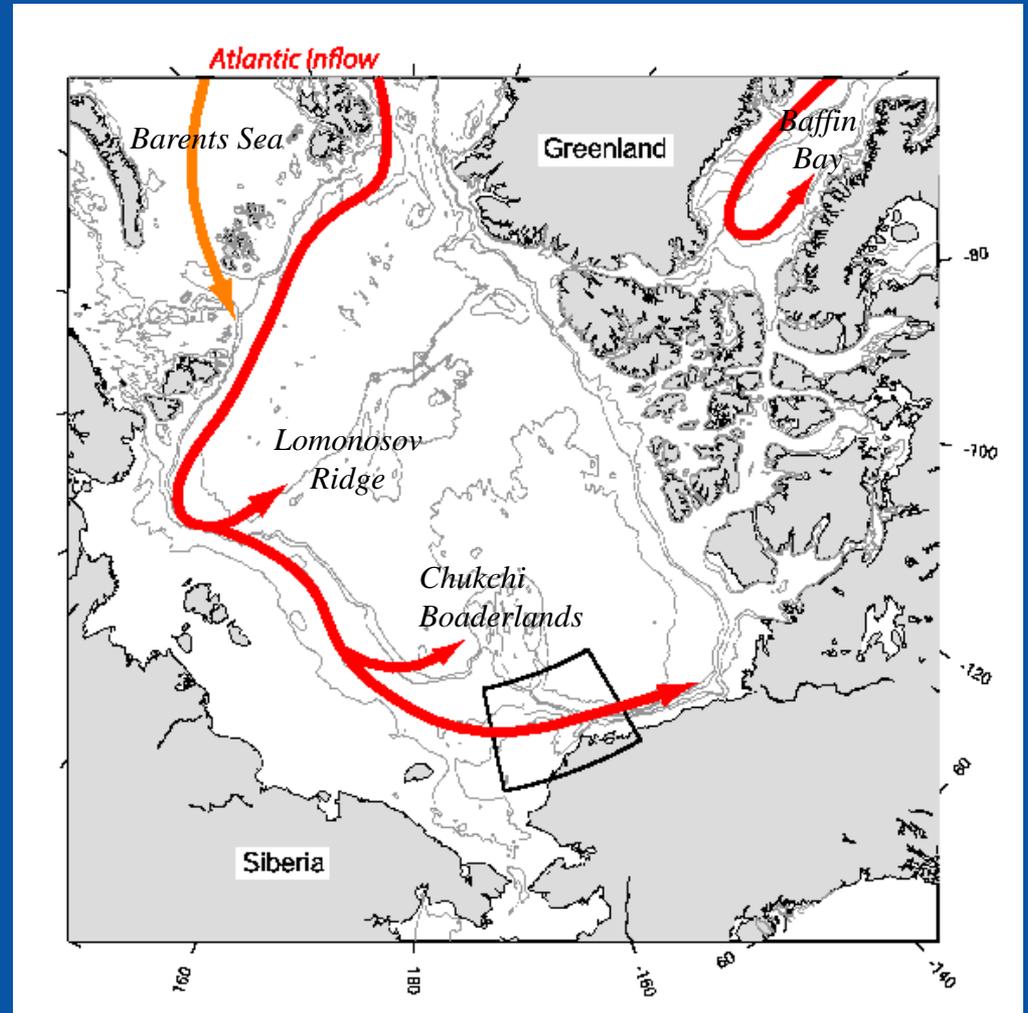
Year-long Mean fields from SBI 152°W Mooring Array



Conclusion: Site SL2 is within an eastward current of Atlantic Water



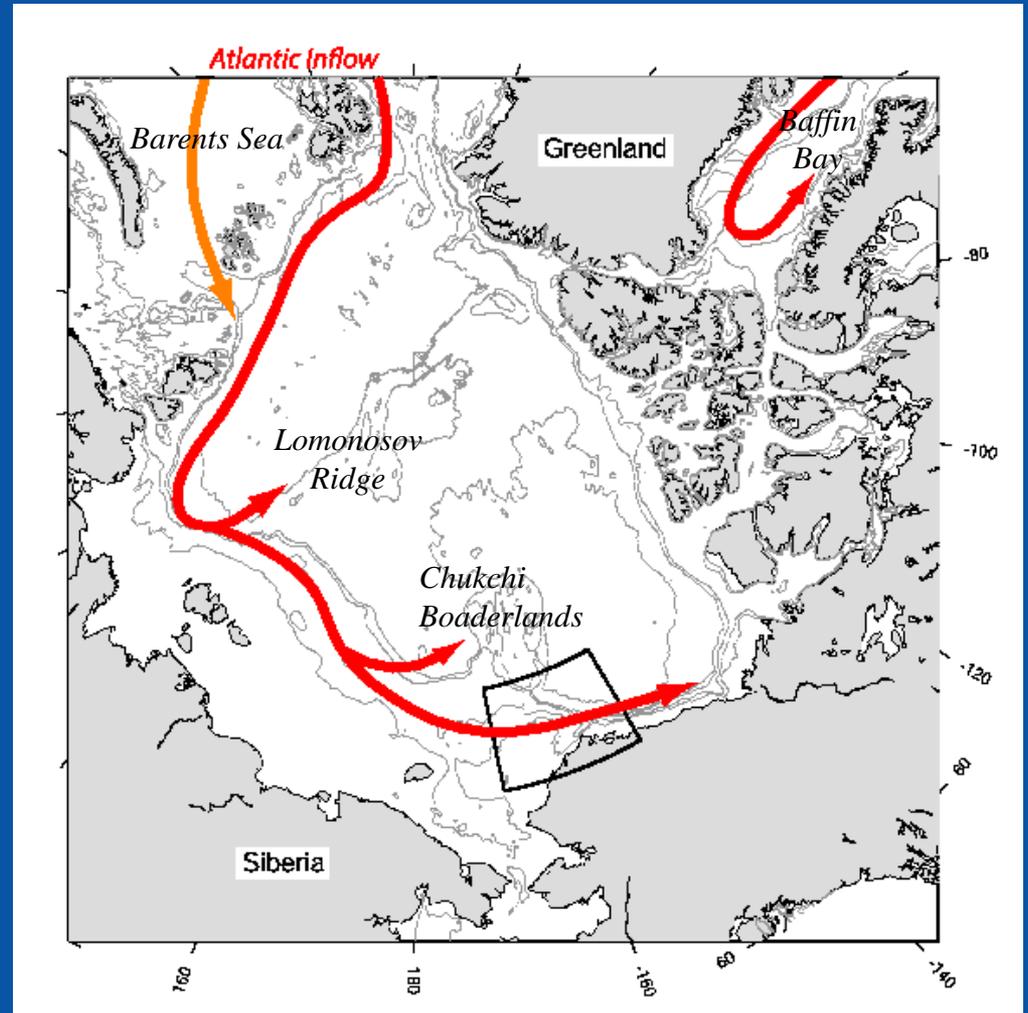
Role of Atlantic Warming





Role of Atlantic Warming

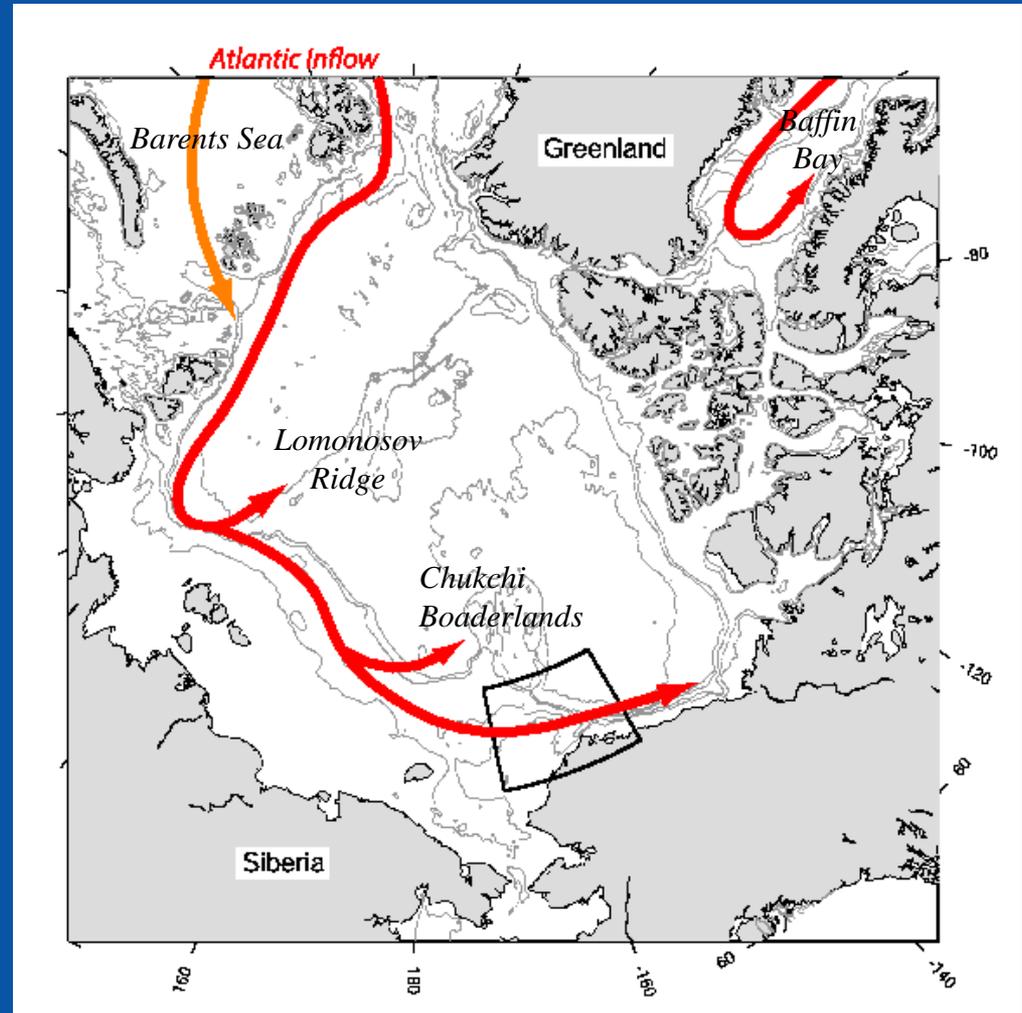
- Warming of AW inflow since 1980.





Role of Atlantic Warming

- Warming of AW inflow since 1980.
- Two pronounced pulses: one around 1990 and the other around 2000, tracked by hydrographic sections and mooring data.

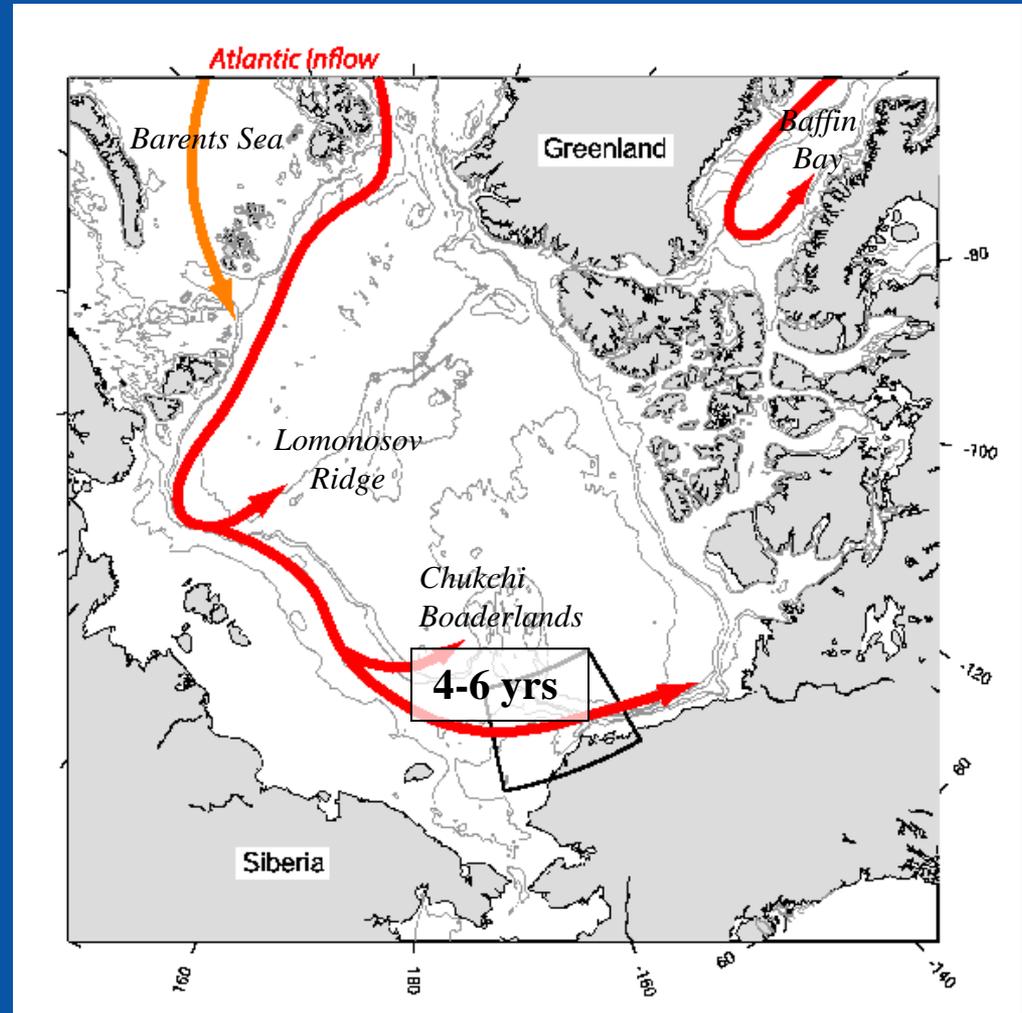




Role of Atlantic Warming

First pulse:

- Shimada et al. (2004) deduced that it reached the Boarderlands in 4-6 years.

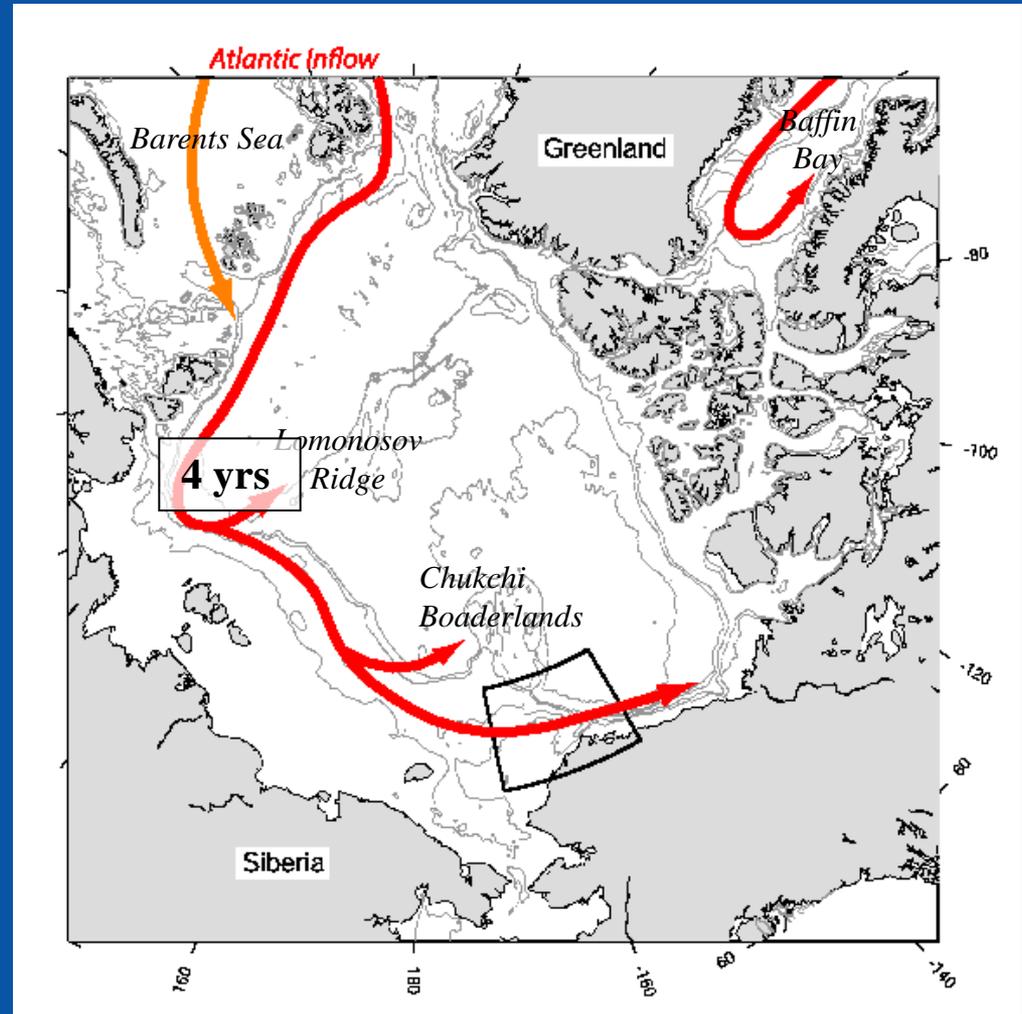




Role of Atlantic Warming

Second pulse:

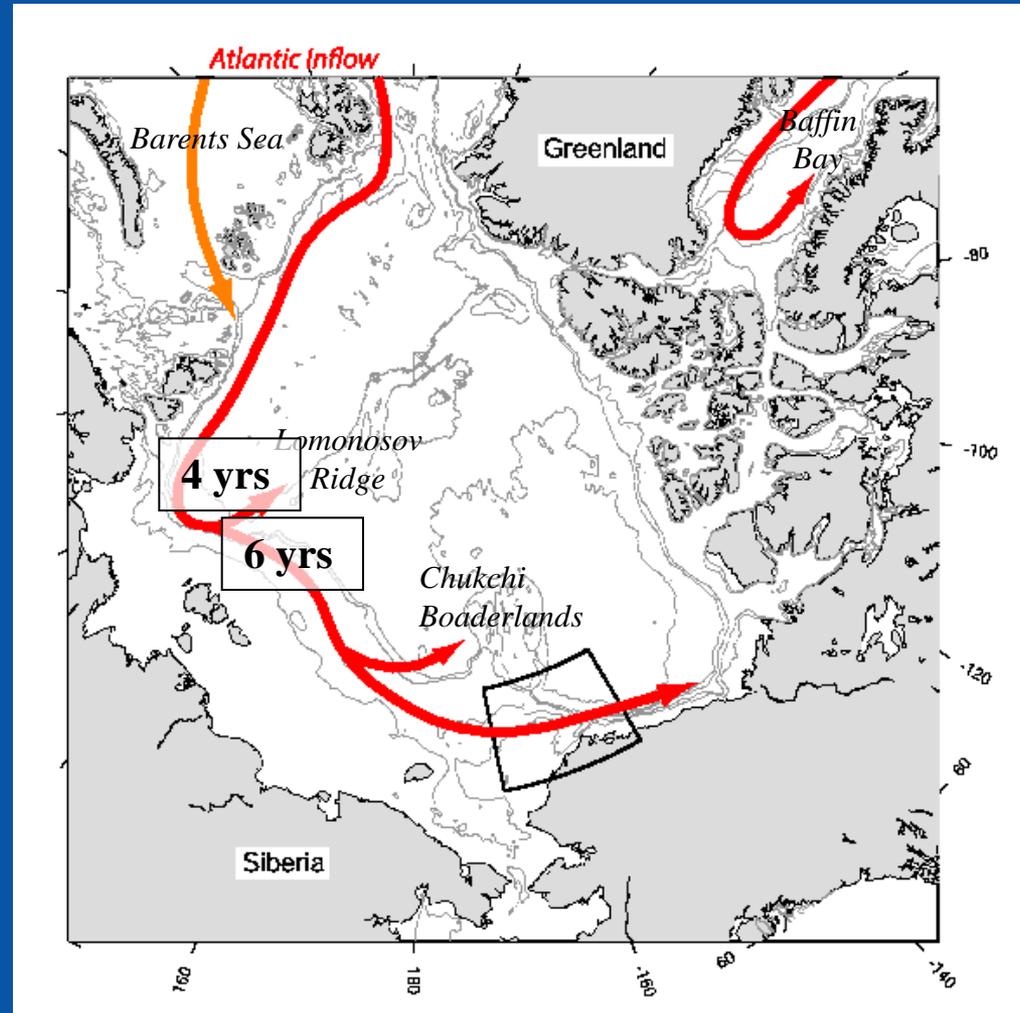
- Polyakov et al. (2005) argued that it took 4 yrs to reach the Northern Laptev Sea.



Role of Atlantic Warming

Second pulse:

- Polyakov et al. (2004) argued that it took 4 yrs to reach the Northern Laptev Sea.
- Dmitrenko et al. (2008) deduced that it took 2 more yrs to reach the other side of the Lomonosov Ridge [this pulse spread more effectively along the ridge.]

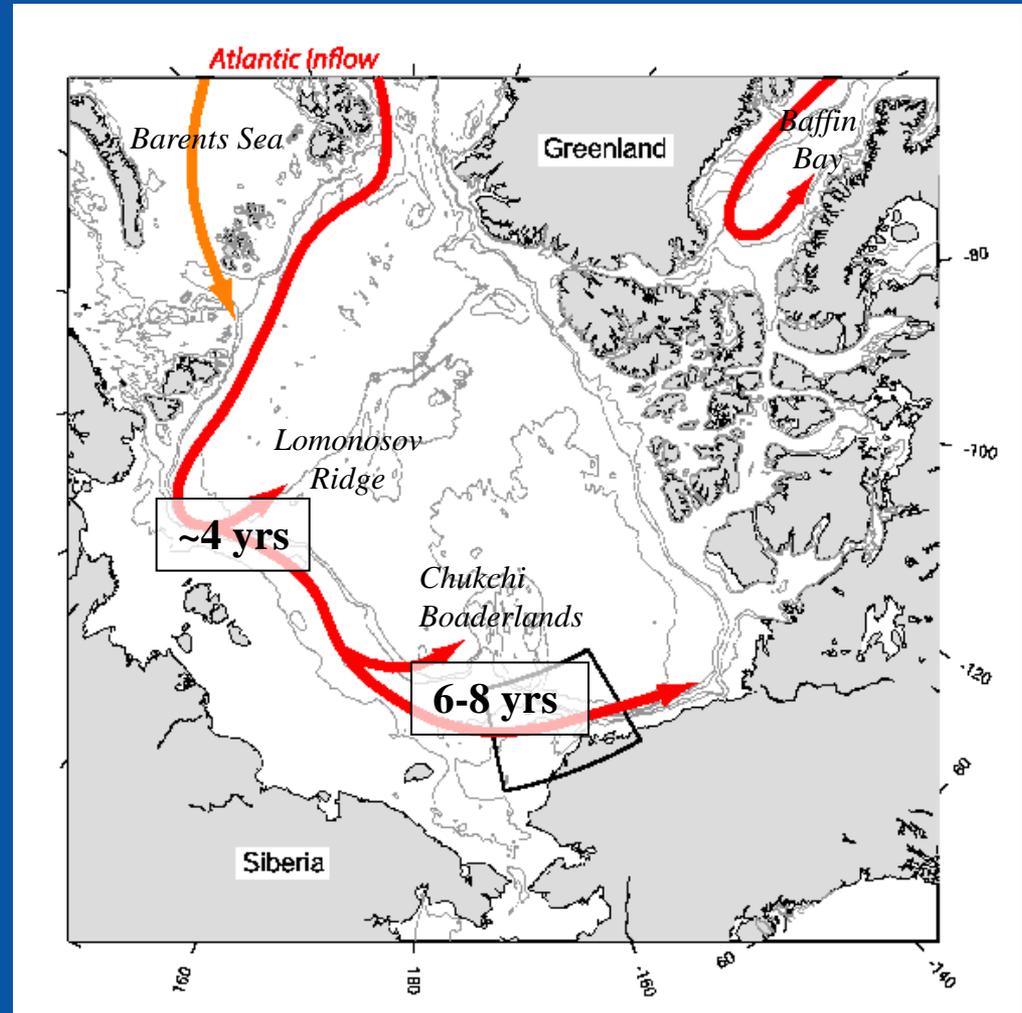




Role of Atlantic Warming

Overall:

Approximately 4 yrs to reach the ridge, and perhaps another 2-4 yrs to reach the Chukchi slope.

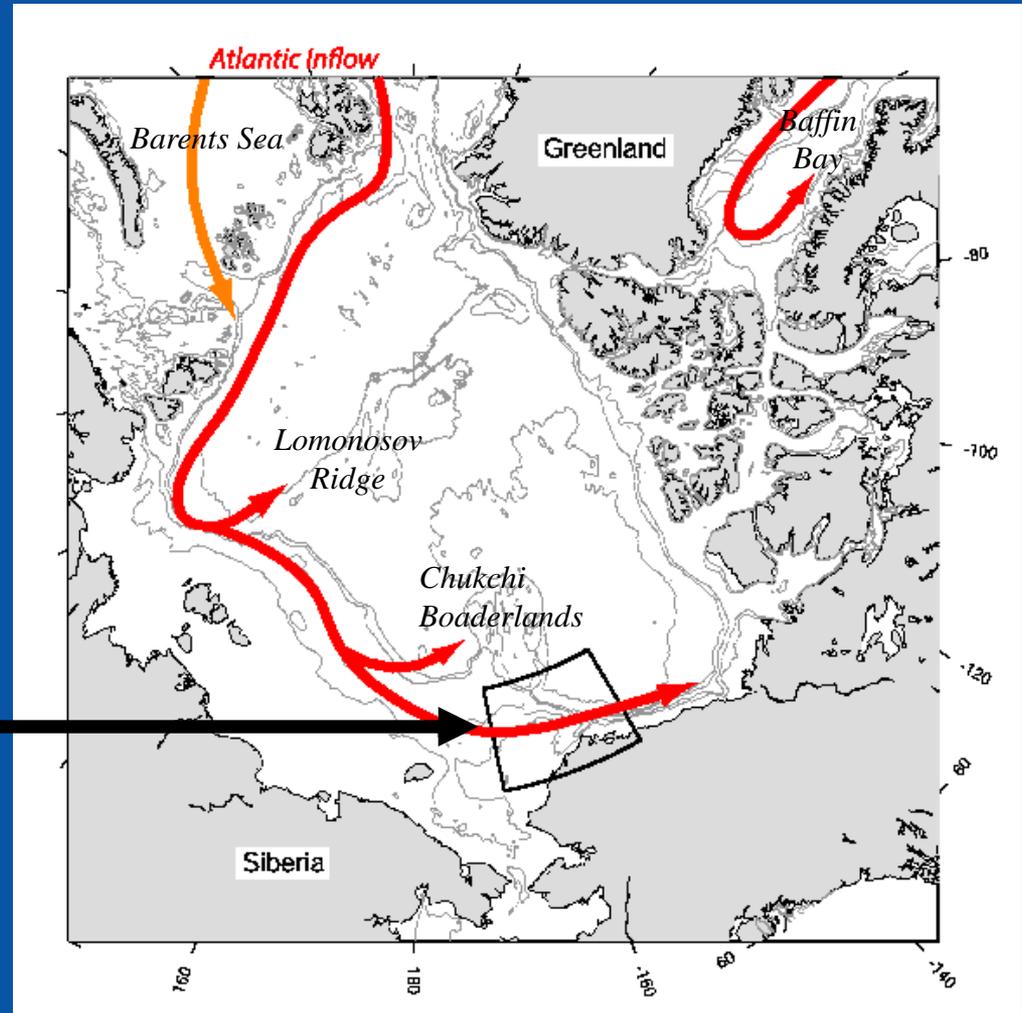




Role of Atlantic Warming

Crude Estimate of Arrival at Chukchi Slope

First pulse: ~1996
Second pulse: ~2008



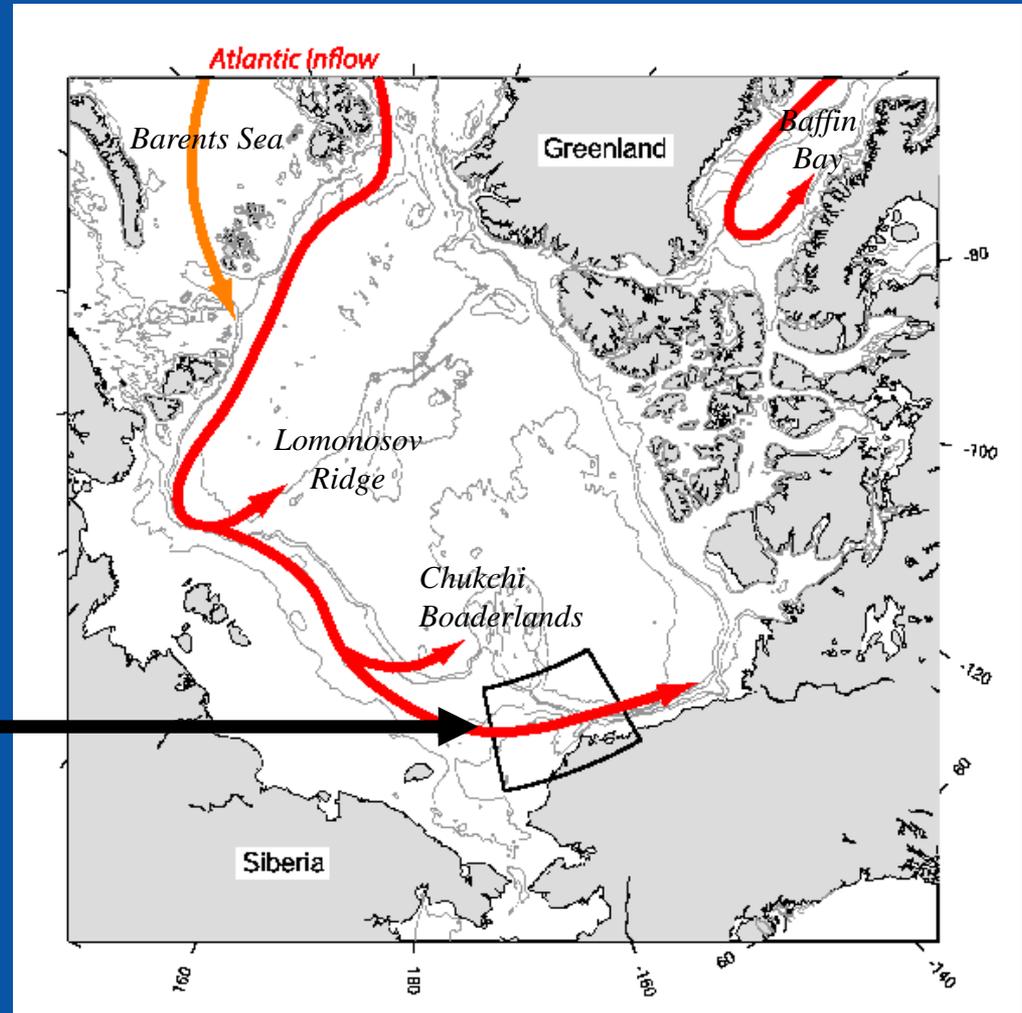


Role of Atlantic Warming

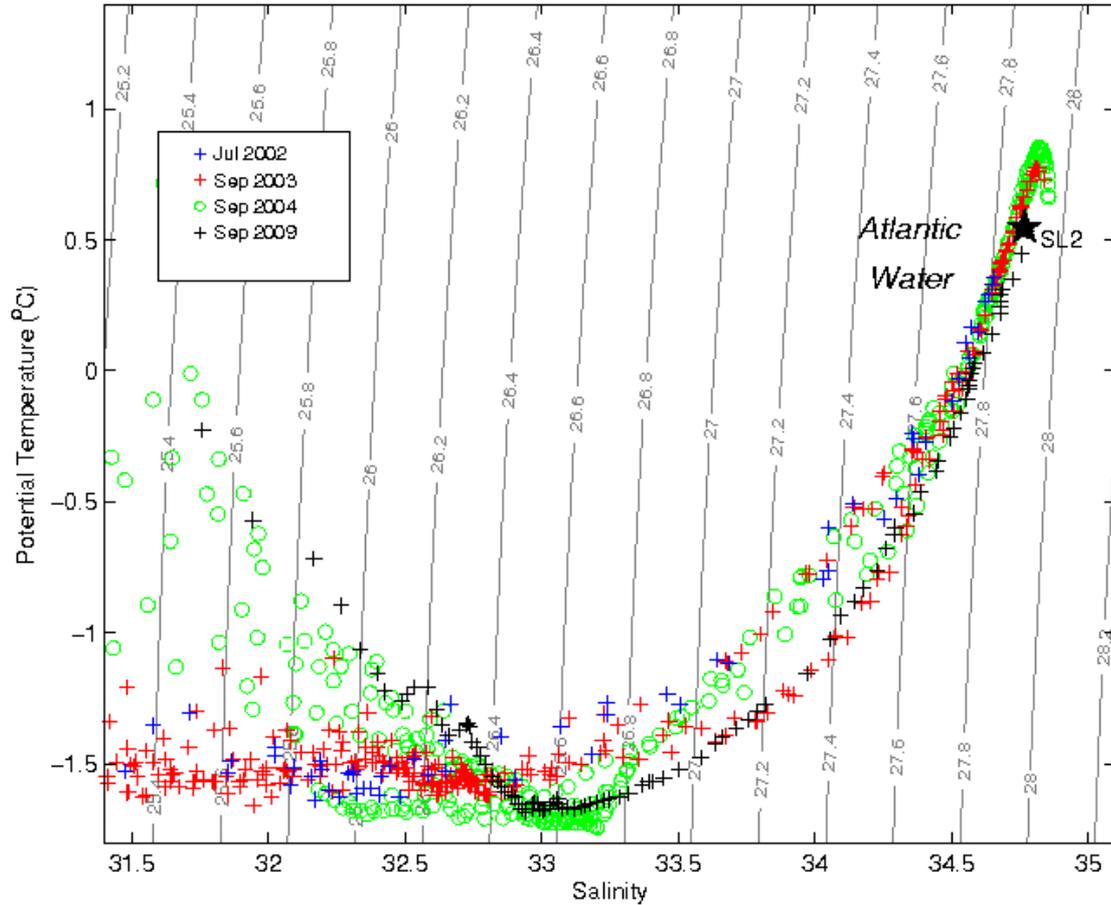
➔ Atlantic species measured by Khromov arrived in the second, warmer pulse?

➔ 2009 Atlantic Water should be warmer than 2002-4 Atlantic Water during SBI

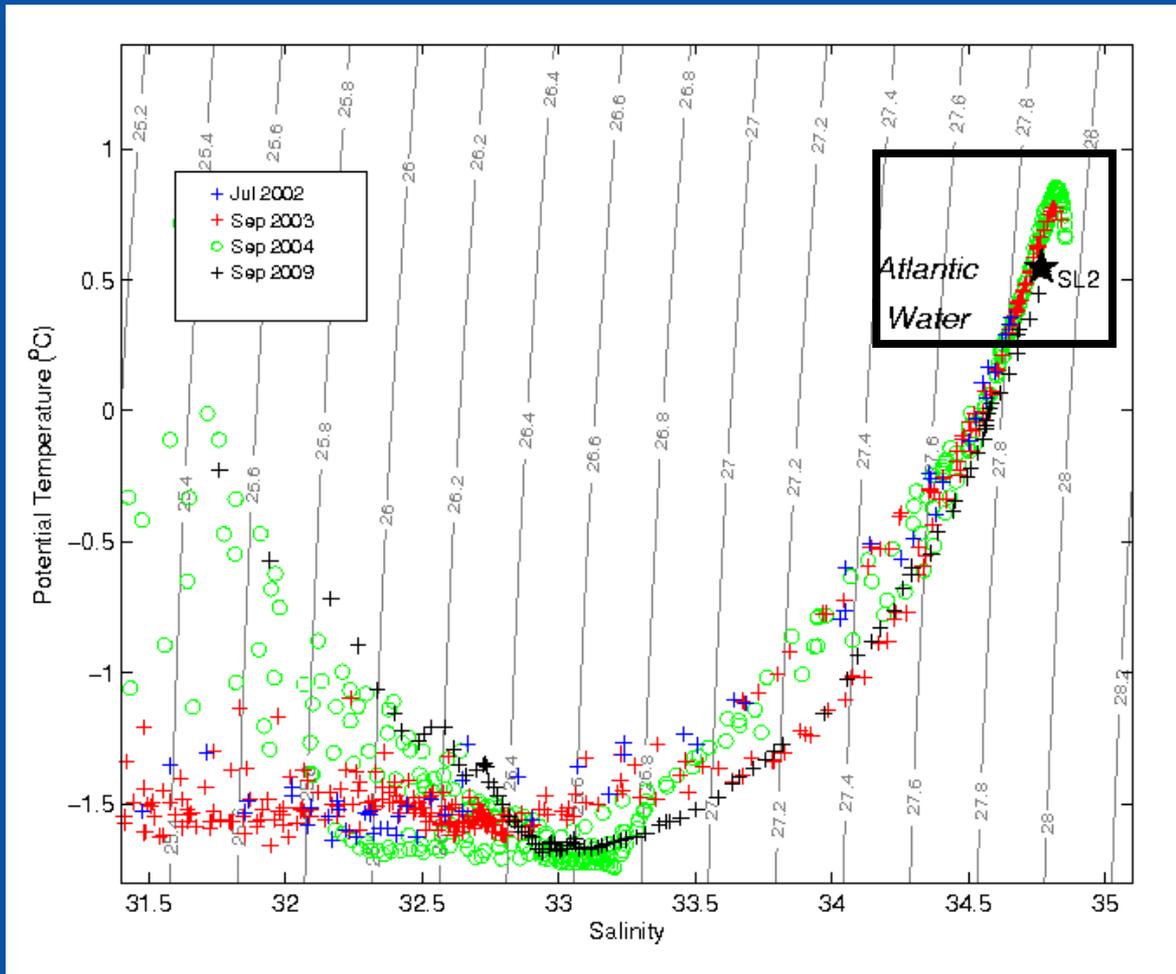
First pulse: ~1996
Second pulse: ~2008



Temperature/Salinity Diagrams

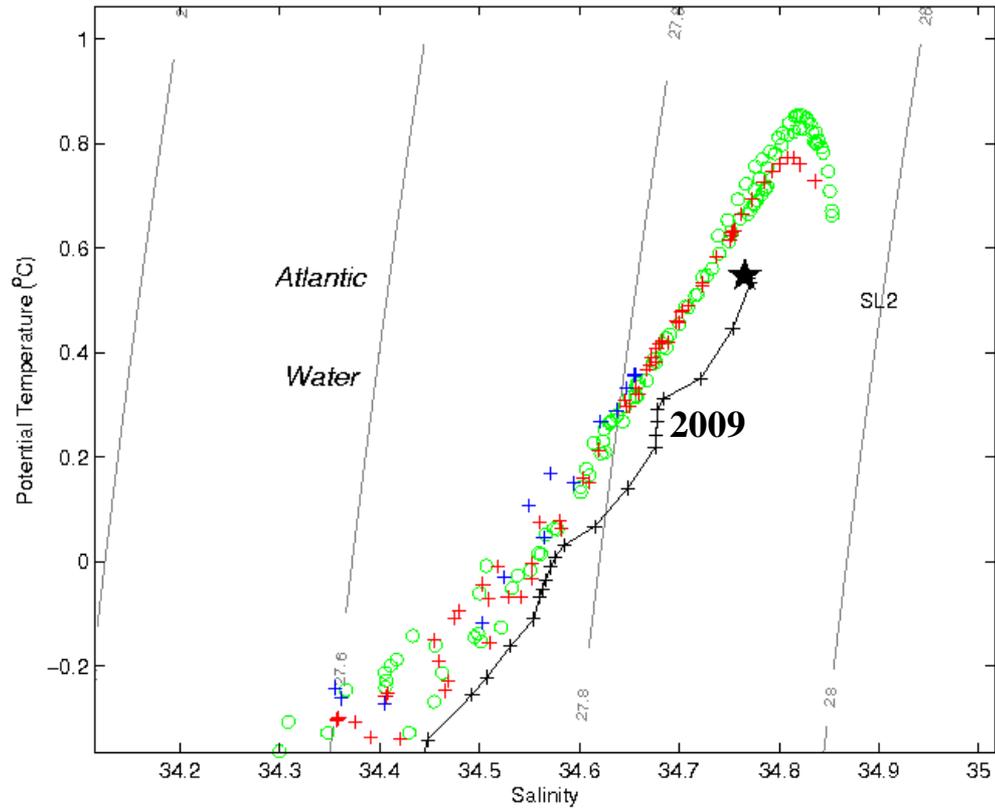


Temperature/Salinity Diagrams





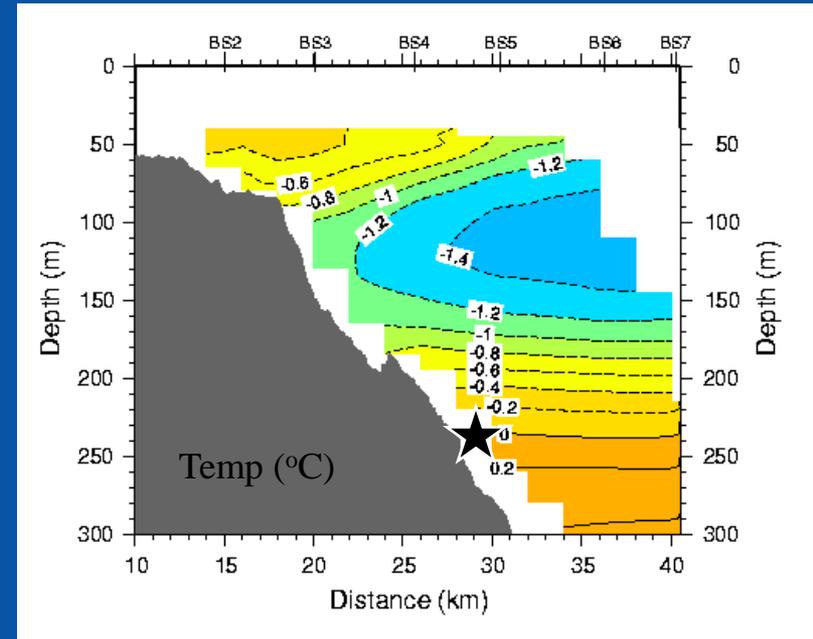
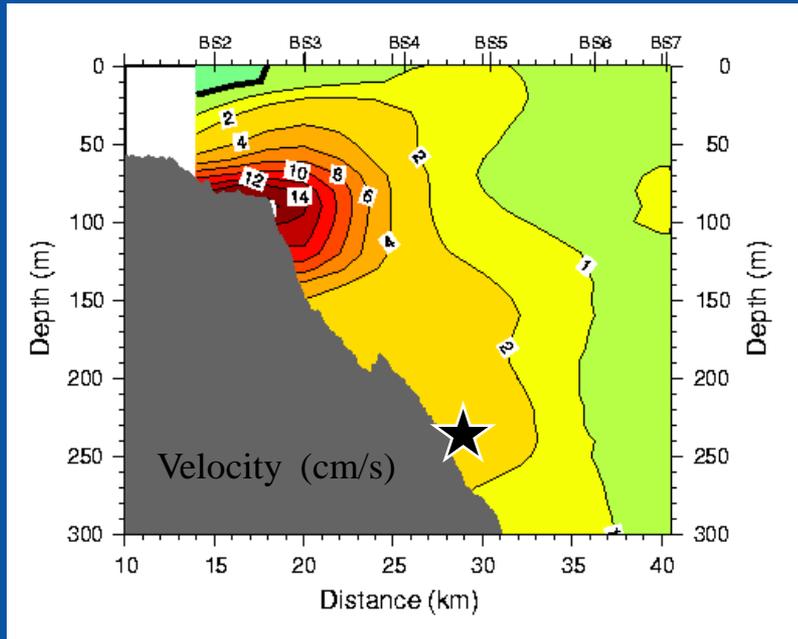
Temperature/Salinity Diagrams





Impact of upwelling

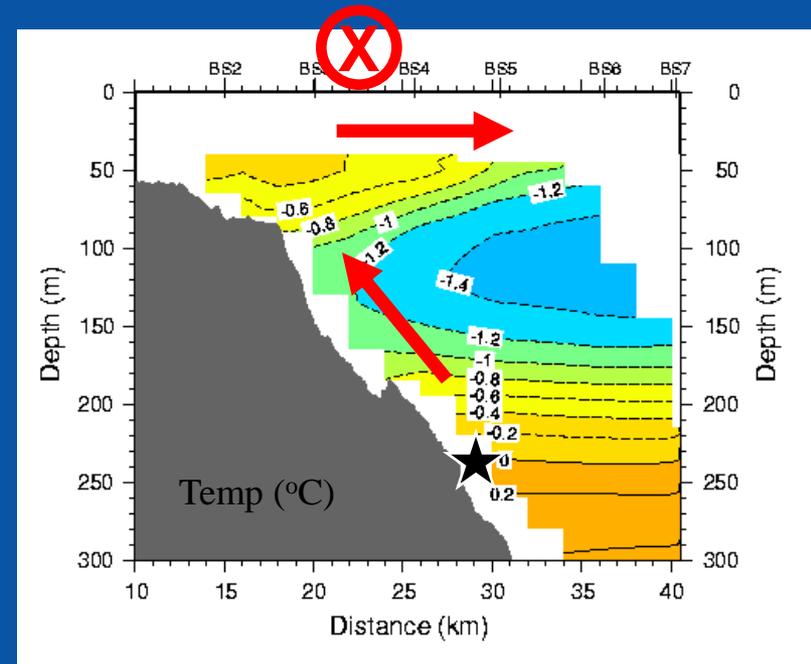
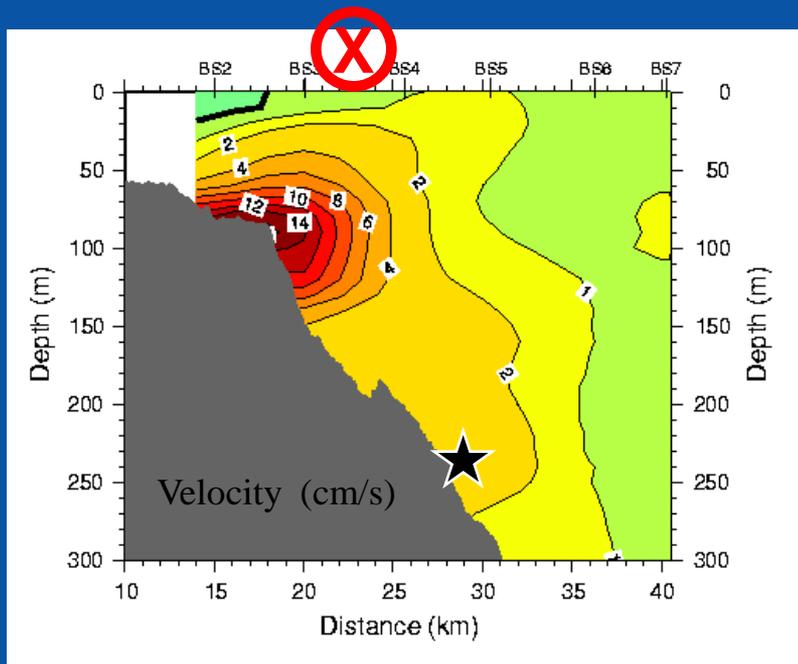
Year-long Mean fields from SBI 152°W Mooring Array



SL2 site is subject to high mesoscale variability

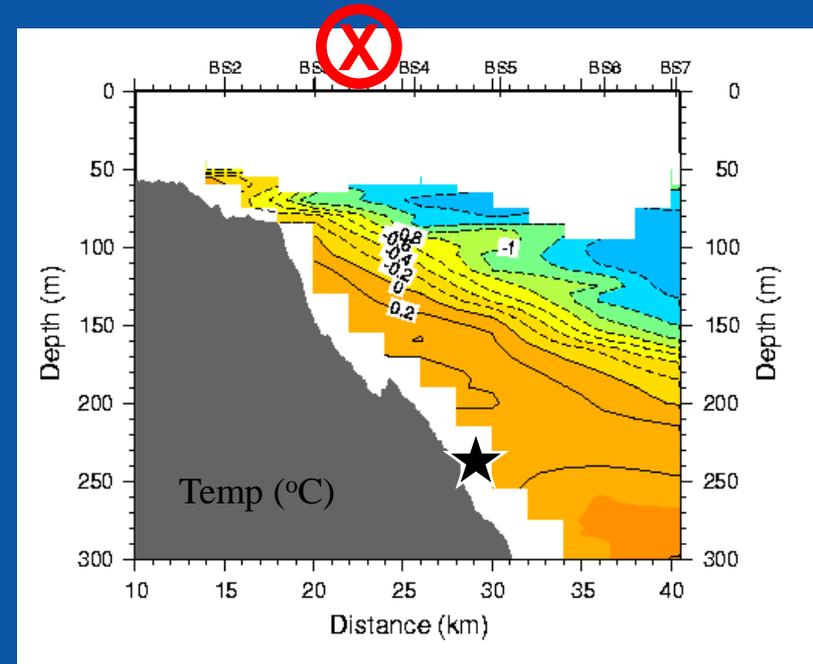
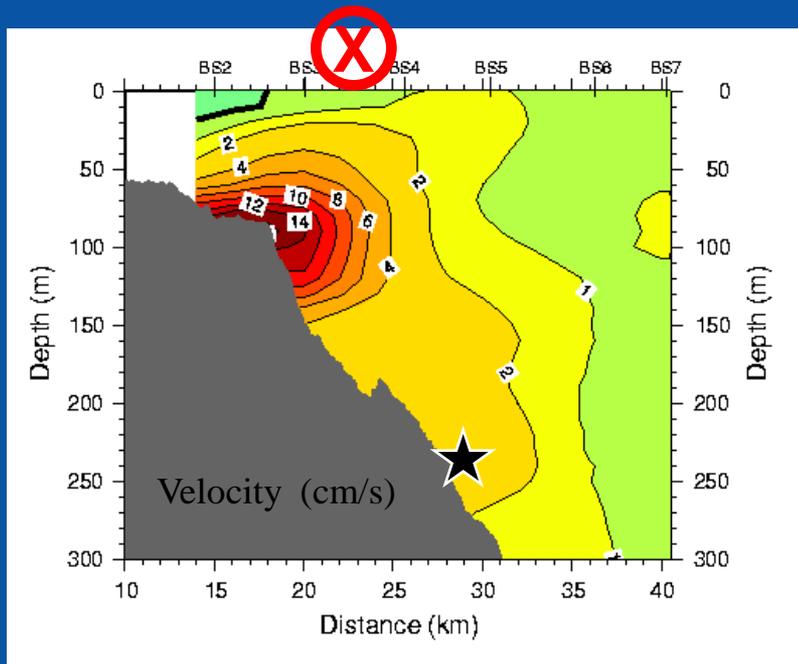
Impact of upwelling

Year-long Mean fields from SBI 152°W Mooring Array



Both the 2003 and 2004 SBI 166°W sections were occupied during/after enhanced easterly winds...

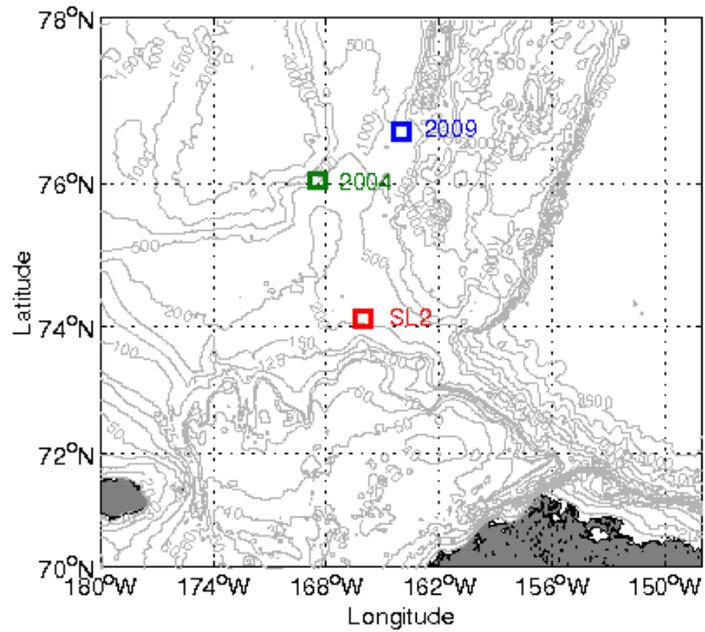
Upwelling along the Beaufort slope



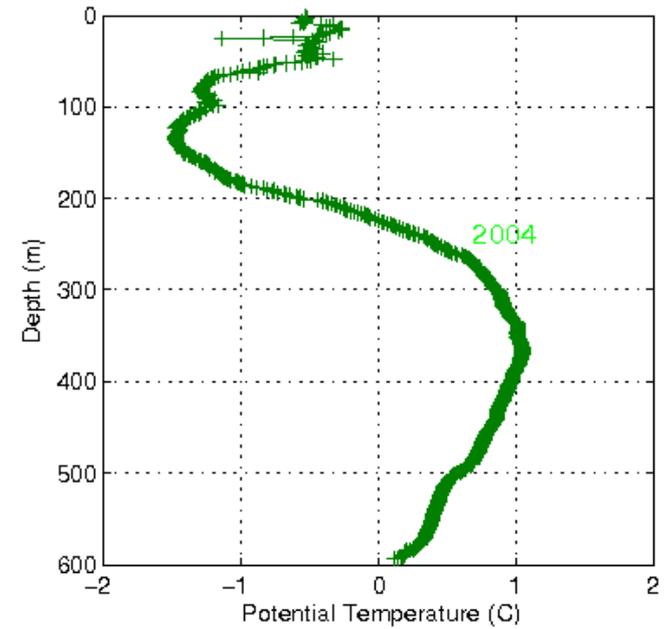
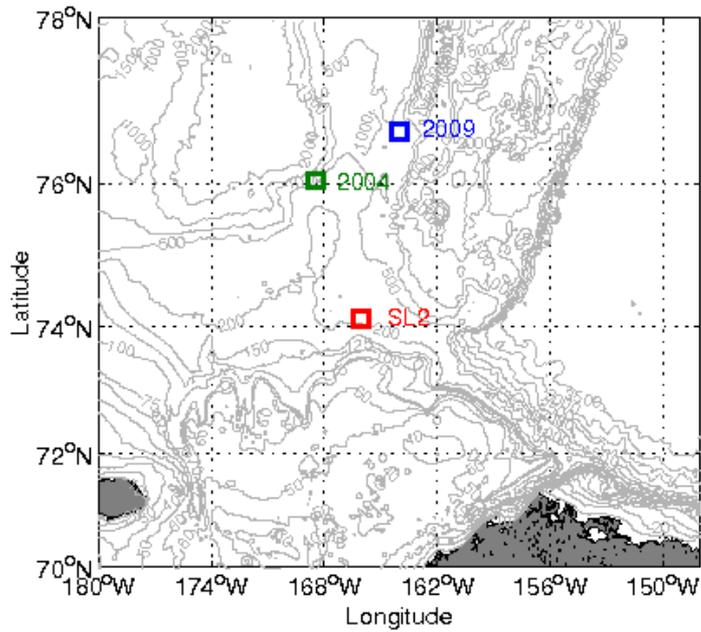
Upwelling storm in Nov 2002



Atlantic Water comparison

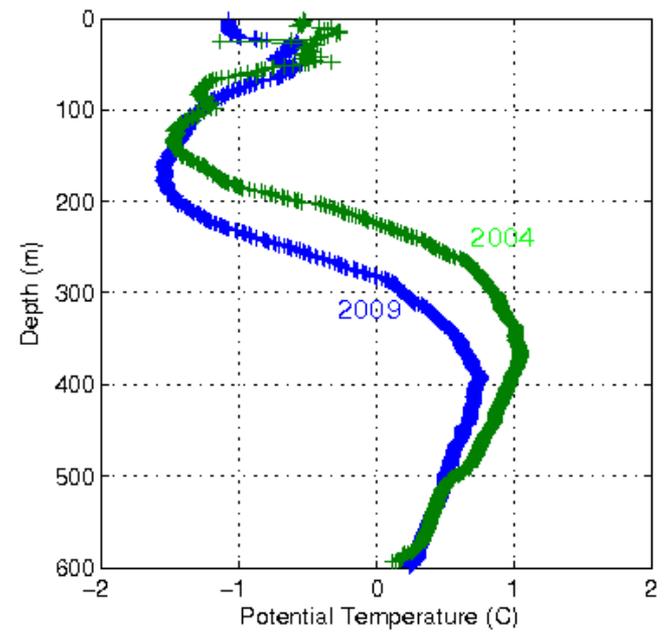
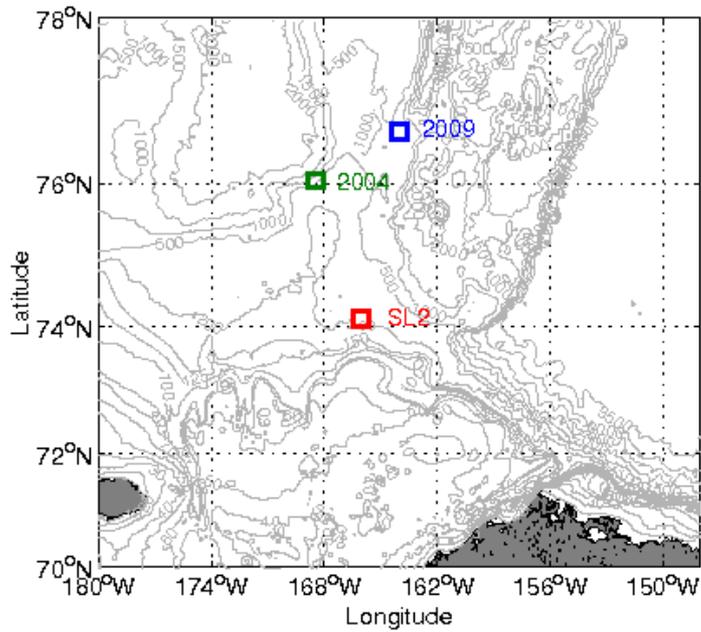


Atlantic Water comparison



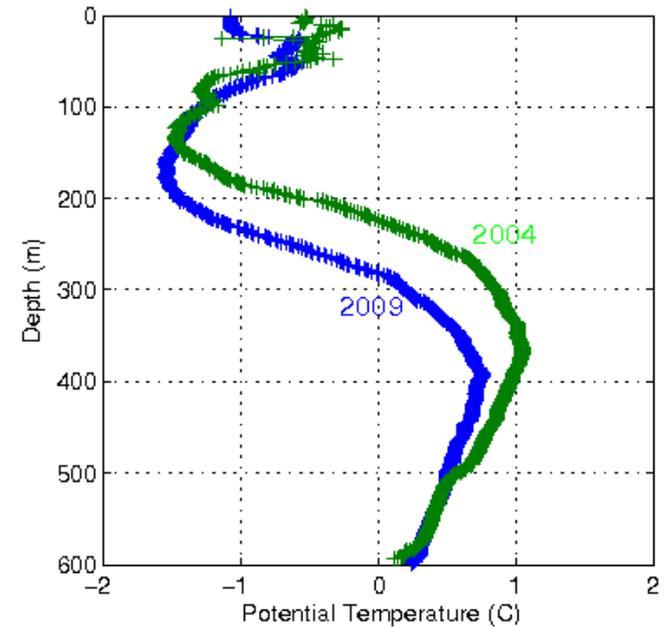
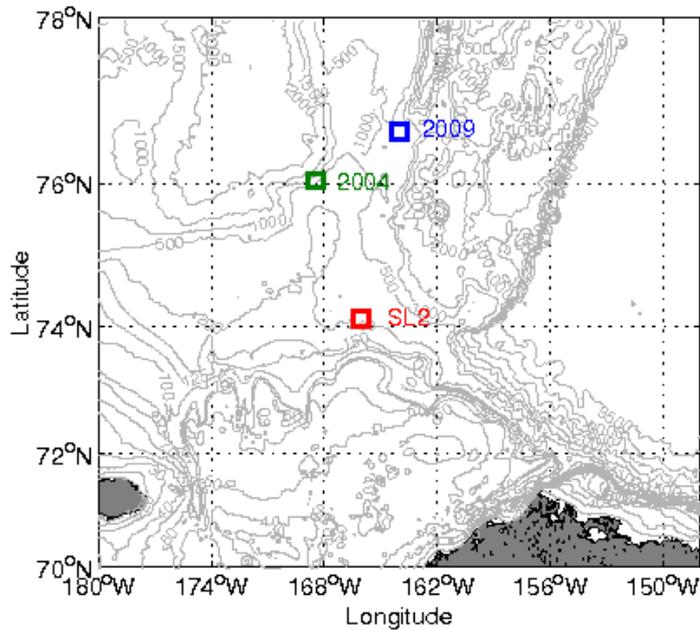


Atlantic Water comparison





Atlantic Water comparison



Implication: 2004 was at tail end of first pulse; 2009 was in between pulses when the temperature had lowered.



Conclusions

- 1. The Atlantic species of fish caught at site SL2 (and probably SL1) were in the upper AW layer. If advected, they likely came from Fram St. via the AW boundary current.**
- 2. It is difficult to tie the presence of the fish to either of the recent pulses of warm AW (apparently between pulses).**
- 3. However, in light of the general warming of AW since 1980 it is possible that a threshold was reached allowing the fish to make the long transit to the western Arctic.**



Thank you

RUSALCA 2009
(Photo by D. Torres)